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TECHNOLOGY ACCEPTANCE OF SMARTPHONES AS MOBILE LEARNING TOOLS: A CONTEXTUAL COMPARATIVE STUDY OF ENGINEERING AND EDUCATION COLLEGES

A thesis submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy in Education

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Disclaimer

All the content presented in this thesis is the original work of the candidate except as acknowledged in the text, and has not been previously submitted, either in part or in whole, for a degree at this or any other University.

Abstract

Smartphones today are ubiquitous and are influencing our everyday life and have unsettled many age-old tasks, activities, devices, gadgets, tools and technologies with their redefined usage and definitions. They have relatively strong computing capabilities built into small sizes that offer versatile communication possibilities and are equipped with intuitive operating systems, smart sensors and applications. They have a great potential to be used as learning devices owing to their connectivity and versatility to suit various learning styles and learner preferences. The understanding of parameters which govern the customised integration of smartphones is the key to a successful acceptance and assimilation of these devices as learning tools.

Technology acceptance models are used in studies aimed at predicting and explaining the user's behaviour towards the acceptance and usage of new technologies. This study adopted the Unified Theory of Acceptance and Use of Technology (UTAUT2) model along with educational context, gender and educational level as moderators. This study at the outset hypothesised that the educational context plays a key role as a moderator in the acceptance of smartphones as learning tools and hence will influence the variables in the UTAUT2 model. Context based mobile learning also assures learners that learning content can be matched, adapted or selected according to their current learning situation and contextual educational environment.

To understand smartphone technology integration, this research compared the two context groups, one from the College of Engineering (CX1) and the other from the College of Education (CX2), both from the same university cohort. They were chosen according to the contrasting differences in their programs, curriculum, pedagogy, student aptitudes and required skills. The two groups were sampled from a university in New Zealand. This research terms these two groups as two different "contexts" of education.

The survey instrument was designed and developed after conducting Pilot studies. The final survey questionnaire was distributed and about 310 were collected from the university students. This study then adopted a two-step confirmatory factor analysis

technique. In the first step, it extracted the best items using the Principal Component Analysis factor extraction method. In the second stage, the structure model was developed to assess the four set hypotheses of this research.

The results from the data analysis of this research strongly confirm the influence of educational context as a moderator in the acceptance of smartphones as mobile learning tools. The major contributions of this research are that the UTAUT2 model was found to be a significant predictor of the student's behaviour intention to use smartphones as mobile learning tools. The other key contribution of this research was redefining the two original UTAUT2 constructs, Social Influence and Facilitating Conditions. The Social Influence construct was redefined as the influence of peers, classmates and teaching faculty to use smartphones for learning. Facilitating Conditions was redefined as receiving educational help and support through smartphone connectivity and communication.

Researchers typically assess the effect of moderators on technology acceptance by considering effects across disciplines/courses. This research focussed on multilevel moderator comparisons (inter and intra groups) to assess the effects of the educational context moderator on acceptance, current models of predictors of acceptance and the moderating influences of gender and educational level. Such inter and intra comparisons should inform our understanding of how a highly personalised device such as the smartphone can be integrated contextually for students as a learning tool. The findings highlight the potential factors that may enable the acceptance of smartphone-based mobile learning within a university environment.

Publications from this Research

Book Chapter (Peer Reviewed)

Ahmed M. S. (2016). Framework to develop a learning analytics system for smartphone blended learning environment, Handbook of research on mobile devices and applications in higher education settings (pp. 72-91): IGI Global. (Published)

Journal Articles

Ahmed M. S. (2016). Everatt J., Fox-Turnbull., W. Smartphones for Engineering Education. Journal of Technology in Education. (Under Review)

Ahmed M. S. (2016). Everatt J., Fox-Turnbull., W. Instrument Validation Using Factor Analysis on Student Adoption of Smartphones for University Education: Empirical Evidence from UTAUT-2 model. (Under Submission)

Ahmed M. S. (2016). Everatt J., Fox-Turnbull., W. A Comparative Study of College of Engineering and Education for the Factors that Affect the Students Adoption of a Smartphone as a learning tool using UTAUT2 model. (Under Submission)

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Ahmed M. S. (2016). Smartphones for Engineering Education. "Learner-2016" 23rd International Conference on Learning. (Conference)

Ahmed M. S. (2016). A methodology to study the Acceptance of Smartphone as a mobile learning tool. DEANZ Conference 2016. (Poster)

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Dedication

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Chapter 1

1.0 Introduction

1.1 Overview

This thesis investigates the acceptance of the Smartphone as a mobile learning tool by comparing two colleges from a single university in New Zealand. This will be accomplished using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model (Venkatesh, Thong, & Xu, 2012). The two colleges compared in this research are the College of Engineering and the College of Education. The model was modified to incorporate redefined parameters and the three moderating factors - context of education, gender and the level of education.

This research followed a comparative assessment of inter and intra group comparisons of all the moderators between the two contexts. This comparative assessment was aimed at exploring the similarities and differences between the two groups, which will subsequently help to understand the concept of technology acceptance and integration of the Smartphone as a learning tool in a university setting. The findings should be applicable across a range of similar contexts, content delivery types, collaboration channels and mobile learning management systems.

1.2 Research Background

Mobile and communication technologies are ever-evolving and have changed the world. Many of these changes are highly significant in education. The rise and popularity of smartphones in particular, has paved the way for mobile learning which is commonly referred to as “m-learning” (Motiwalla, 2007; Quinn, 2001). This new way of learning leverages the mobile phone’s portability and ubiquity to deliver content and provide new ways of teaching and learning (Traxler, 2005). There is great potential for m-learning, as mobile technologies are expected to reach the farthest corners of every continent. They cover demographics, economic status, gender and age (Quinn, 2001, 2011). M-Learning has a potential to offer techniques such as personalised learning, contextual learning, situated learning, collaborative learning, ubiquitous learning, lifelong learning, just-in-time learning, micro learning, rich media learning, immersive learning, synchronous learning and asynchronous learning (Franklin, 2011).

Universities have witnessed a concomitant surge in the number of students owning at least one or more mobile devices. According to a recent report published by the British Broadcasting Corporation (BBC), there are more than 1000 universities that are using iTunes U pages (Apple Computers' educational repository) (Coughlan, 2011). The same report notes that there are more than 107,834 educational mobile applications and 700,000 e-books available for Apple devices. Vate-U-Lan (2008) predicts mobile campuses and wireless universities to be commonplace by 2016.

Berking, Haag, Archibald, and Birtwhistle (2012) believe that mobile learning is not simply a different mechanism for delivering content to learners but that it is an ever evolving educational concept that incorporates mobile technology. This new system entails a paradigm shift where a rethinking is required of current educational strategies with the addition of mobile technology.

In universities which incorporate both face-to-face and online learning, formal and informal learning can be effectively merged as blended learning. Researchers envisage that students have universal access to mobile technologies, thus both formal and informal learning can be accessed as required (Franklin, 2011; Liu, Li, & Carlsson, 2010; Shudong & Higgins, 2005). This kind of blended learning can be achieved either by establishing a mobile phone computing plan in universities with every student being supplied a personal mobile device, or by implementing a 'Bring Your Own Device' (BYOD) model with students bringing along their own devices (Parnell & Bartlett, 2012). These mobile devices may include laptops, tablets, e-readers and smartphones, etc. (Lai, Khaddage, & Knezek, 2013). Blended learning offers significant benefits for educational institutions when they are conscientiously implemented (Vaughan, 2014).

As the basis of this research is on the use of smartphones in education, it follows that those capabilities of the Smartphone that are applicable to education must be identified. The important features of smartphones which are relevant to learners include long battery lives, SIM (Subscriber Identity Module) cards, touch screens, millions of downloadable applications, a large spectrum of communication possibilities (phone calls, video conferencing, text messaging, social networking and accessing email), as well as a relatively high computing power, to list a few merits (Godwin-Jones, 2011).

Smith (2015) posits that the Smartphone offers its user complete liberty to decide which apps to download and use, which internet data plan to choose, how to store data (on the Cloud or on the device), choice to retain it secured with personalised device settings, etc. The almost universal appeal and use of the Smartphone coupled with the wide range of services it offers, makes it a dynamic tool in education.

1.2.1 The Growth of Smartphones

The Smartphone is digitally personalised and addictive with a widespread usage. In contemporary public life where everything moves at a fast pace, people require easy access to advanced technology and services. For most of us, smartphones have become a necessity with many of our daily activities dependent upon their use. Similar to a Swiss Army Knife, the Smartphone’s features support a wide range of tasks which include internet navigation, listening to music, communicating, and shopping, among many others (Rodrigues, Montague, Nicolau, & Guerreiro, 2015).

The impact of smartphones in our lives can be assessed by the global Smartphone market with shipments rising by 40 percent in 2013 to exceed 1 billion units (Weiss, 2015). Weiss also forecasts Smartphone connections to exceed 2 billion units by 2018, mostly led by the two giant brand names - Apple and Samsung. This growth of smartphones has been accompanied by a significant disruption to the PC and web-based computing ecosystems. Services which were formerly only provided for computer users have gradually been made available to Smartphone users (Shin, Shin, Choo, & Beom, 2011). Wang, Xiang, and Fesenmaier (2014) posit that smartphones transform individuals’ daily lives. The same research found that respondents used smartphones over desktops and laptop computers for increased communication with family and friends, increased information searches, exploration of new apps, utilization of free time and for other minor tasks.

1.2.2 Integrating Smartphone Technology in Education

According to Rysavy (2010), a Smartphone is a 'clever' device with high-quality communication services; it is portable, user-friendly, interactive and most importantly it is highly customisable. As a study tool, the Smartphone comes with a large number of apps that allow learners to create and review learning content anytime and anywhere (Connect, 2013; Sharples, Arnedillo-Sánchez, Milrad, & Vavoula, 2009). The Smartphone's commuting power offers a good alternative against bulky laptops (Vinci & Cucchi, 2007). Smartphones offer excellent choices for eBooks and facilitate tasks such as reviewing, reading, finding research articles and taking notes; thus making the Smartphone an ideal tool for students (Lam, Lam, Lam, & McNaught, 2009). Peter, Marcus, Shane, and Jason (2013) marked the following Smartphone features that could aid in conducting successful mobile learning, as shown in table 1.

Table 1: Smartphone feature and its respective Mobile learning use, Peter et al. (2013)

No	Smartphone Features	Mobile Learning Use
1	Cameras	for capturing videos and images, augmented reality
2	Quick Response	(QR) code reading
3	Document Viewers	eBooks, PDFs
4	Geolocation	GPS, geo-fencing, map
5	Internal Sensors	accelerometer, barometer, compass, gyroscope, proximity sensors
6	Media viewers	image, video, audio, podcast
7	Microphones	voice recording, podcast
8	Notifications	alert, sound, vibrate
9	Search engines	discovery, quick-reference, search engine
10	Short-range communication	(Bluetooth, Near Field Communication (NFC)
11	Radio Frequency Identification	RFID
12	Text Messages	Short Message Service (SMS)
13	Multimedia Message Service	(MMS)
14	Touchscreen	interaction and Voice/phone communications

Grant (2015) identified eight different types of learning which can be delivered using the Smartphone; these are Primary Learning Content (Formal), Secondary Learning Content (Informal), Blended Learning, Smartphones Communication, Productivity, Mobile Computing, Learning Analytics and Life Long Learning. Smartphone-based learning modes can offer an excellent platform for instructors to take on the role of facilitators in a variety of roles. Instructors can design rich tasks capable of facilitating higher thinking and promoting learning, knowledge and creativity (Segrave & Holt, 2003).

Universities today invest huge amounts of capital in information technology, e-learning and learning management systems. This expenditure is based upon the presumption of their benefit to students and their preference to use such platforms (Oblinger, Oblinger, & Lippincott, 2005). These costly decisions are often made without a proper assessment or understanding of the factors that influence student acceptance and use of technology. Incorporating these different perspectives in the application of mobile learning can increase its workability and its impact. But the perception of usefulness can also differ between groups – thus, it is critical that user requirements be investigated prior to implementing any system (Davis, 1993). Universities also need student-centred support services for the provision of mobile learning. An understanding of students' habits and practices relating to the use of smartphones can both guide and facilitate this endeavour.

1.3 Research Problem

Wu, Wu, Chen, Kao, Lin, and Huang (2012) posit that the bulk of research in mobile learning had been concentrated on school students, without placing a clear focused investigation on any tertiary education domain. Moreover, the literature review by this same study found that the bulk of these studies investigated the motivations, perceptions and attitudes of students towards the type of mobile device used for education rather than assessing its educational benefits. Wu et al. (2012) also found that the studies conducted in tertiary education on the subjects of engineering, science, language and art were only done in the demographic areas of the USA, followed by the UK and a few countries in South East Asia. This suggests that there is a need to investigate the acceptance of mobile devices like smartphones in the context of New Zealand tertiary educational environments in order to confirm or contrast with other global findings. Furthermore, every country differs in their demography, economy, social contexts and educational curriculum. Hence it is important to conduct a separate research in New Zealand.

A meta-analysis of 199 referred journal articles and proceeding papers conducted by Hung and Zhang (2012) discovered that research in the fields of m-learning is at the early adopter's stage. The same research also posits that most of the studies in the domain of m-learning study the effectiveness of learning content. In another meta-analysis research conducted by Wu et al. (2012), 164 referred journal articles published from 2003 to 2010 in major journals, established that many studies focused only on assessing the effectiveness of mobile learning system design but none of them focused on Smartphone acceptance in education.

Hung and Zhang (2012), in their literature review of mobile learning studies, reveal that due to the relatively shorter history of m-learning than that of its predecessor (e-Learning), there are not many studies that focus towards understanding its trends based on longitudinal research. Another similar literature review revealed that there is a gap in identifying the theoretical practices for undergraduate education and the use of mobile devices for learning (Fernandez, Simo, & Sallan, 2009).

1.3.1 Integration of Digital Device in Universities

Institutions in many countries are witnessing a trend termed 'leapfrogging' among their youth, in which smartphones are the main points of internet access as opposed to laptops and desktops (Napoli & Obar, 2013). With data and research on technology acceptance, institutions may find better learning opportunities for both flexible and inflexible users (Dillon & Morris, 1996). Vaughan (2014) posits that the inception of online collaborative applications have given innovative methods of interaction between students, peers, teachers and content. Academic institutes that better understand the technology acceptance process (i.e., why and how students choose to adopt and use a specific technology) and the causes for the acceptance and use of mobile learning, should be in a better place to implement appropriate and innovative technology solutions.

As most universities provide wireless connectivity for mobile devices, the focus on comparing and contrasting the integration of new mobile technologies, such as smartphones, in major areas in education is important to these academic institutions. Such a comparative analysis of cohorts will also help academic institutions to better understand the need to upgrade off-campus learning technologies for higher education. The university setting of the current study provides a suitable context to assess the process of the adoption of technology for education.

1.3.2 Understanding The Digital Generation

The term "Generation Y" refers to consumers who were born between 1980-94, while "Generation Z" covers those born after 1995 (Kumar & Lim, 2008). These generations place a great importance on highly customized applications that cater to their individual and contextual needs. Hope (2015) highlights that most of the students of Generation Y are currently enrolled in higher education, and soon this higher education will witness the enrolment of Generation Z. This research claims that learners of these two generations have shown that they learn differently than their previous generations. Both of these groups are important consumers of smartphones as potential college students; they are often early adopters of new technologies as well as being extensive users (Lee, 2014).

Smartphone technology is characterised by its functionality and is changing the behaviours of students (Yu & Conway, 2012). Lee (2014) in his research asserts that it is vital to study the factors that aid college students in their adoption behaviour of smartphones as they eventually influence the late adopters in an academic population. Vate-U-Lan (2008) asserts that production procedures of m-learning will need staff with knowledge of both mobile applications and instructional design for designing mobile learning content.

According to Pheeraphuttharangkoon, Choudrie, Zamani, and Giaglis (2014), research has usually been focused on merely the concept of using mobile devices and not its acceptance. Wang, Wu, and Wang (2009) suggest that there is tremendous research to assess the technology acceptance in the areas of mobile commerce and banking as opposed to the little research conducted in investigating the factors affecting the millennial generation's intentions to adopt m-learning. It is predicted that the traditional Information Technology (IT) and computing devices which access the internet will very soon converge into mobile Internet services, but there are very few studies which investigate the adoption of mobile technologies for online education (Pedersen & Ling, 2003).

As can be seen by the above literature, it is essential to perform rigorous evaluations of technology acceptance and integration. Researchers must conduct context-based learning assessments similar to those undertaken for e-learning, blended learning and face-to-face learning. More research is required in order to determine whether students perceive benefits in using Smartphone technology for learning (Spencer & Hughan, 2008). Researchers also need to provide systematic data on the acceptance of m-learning systems if the potential of Smartphone technology is to be fully realised.

1.4 Research Model

The need to understand technology acceptance more comprehensively has compelled researchers to develop technology acceptance behaviour models (Jen, Lu, & Liu, 2009). Most of these models are based on the Theory of Reasoned Action (TRA) and the Theory of Planned behaviour (TPB). There are other popular models based on Innovation Diffusion Theory (IDT), Social Cognitive Theory (SCT), and Motivation Theory (MM). The assessment of the validity and efficiency of these models is regarded as one of the most important scopes of research on information management (Hu, Chau, Sheng, & Tam, 1999).

The technology acceptance theory adopted for this research is the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), as previously stated in the overview. The selection of this model was made after a thorough evaluation and assessment of all the prevalent models in the field of technology acceptance, as reported in the hypothesis chapter of this study.

The model UTAUT1 that was first proposed by (Venkatesh, Morris, Davis, & Davis, 2003) gave a better understanding of the acceptance of information systems then the previous prevailing technology acceptance models at the time. The UTAUT1 model was derived after combining the prevailing technology acceptance models such as the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TPB), the combined TAM and TPB, the model of Personal Computer Utilization, the Innovation Diffusion Theory and the Social Cognitive Theory (Venkatesh et al., 2003). Later, Venkatesh et al. (2012) proposed UTAUT2 after identifying three new key components resulting in a substantial improvement in the variance explained in behavioural intention. The redefinition of UTAUT1 involved incorporating three key constructs - hedonic motivation, price value and habit; as well as the alteration of the existing relationships with new connections. Before UTAUT1 was developed, research had shown that models such as Technology Acceptance Model (TAM) could predict 40% of the variance in acceptance of an innovation. Previous literature claimed that the proposed UTAUT2 model could explain 74% of the variance in behavioural intention to use a technology as compared to the UTUAT1 model which could explain only 56% of the variance in behaviour intention to use a technology (Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatesh et al., 2012).

Thus, the UTAUT2 acceptance model used in this research investigates a student's behaviour intention to accept Smartphones in relation with performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price and habit against the context groups, gender and educational level.

1.5 Research Context Rational

The main aim of a mobile learning system is to provide learning experiences that can be delivered through mobile devices and are tailored to meet the specific educational and personal needs of an individual learner or a group of interconnected learners (Jen et al., 2009). Context aware m-learning provides digital age learners with a personalized educational experience in real-time. The Smartphone can also provide learners with adaptive feedback and support. Context based mobile learning also assures learners that learning content can be matched, adapted or selected according to their current learning situation and contextual environment (Cheong, Park, & Hwang, 2004).

Siemens (2004) posits that the three learning theories that are usually used in building an educational environment are Behaviourism, Cognitivism and Constructivism. But the ramifications of information technology have not been incorporated in the development of these theories. Over the past two decades, technology has changed how we live, communicate and learn, thereby creating a social environment with its own contextual needs and requirements (Siemens, 2004). In order to deal with the educational necessities of such an environment, it is important that the learning processes and principles reflect upon those needs.

Siemens (2004) theory of connectivism proposes that institutions, educators and educational technology professionals utilize communication technology to foster connectivism as a learning pedagogy. This theory states that learning is created by forming networks of connection. The principles of connectivism also state that learning is a process of connecting contextual nodes and sources of information. A learner's urge to seek more knowledge is more important than what he or she currently knows. The driving force of connectivism is the intention of seeking knowledge or information which is current and relevant (Siemens, 2014). Connectivist theory has become increasingly common since the 1980s, with the rise of digital technologies (Prensky, 2001).

Cole (1998) endorses that every communication activity takes place in a particular context. Technologies are employed in specific contexts that determine how they can be used. Cole (1998) defines context in the following manner: "that which surrounds us" and "that which weaves together". In short, context is presented as an environment where students continually receive data that is interpreted as meaningful knowledge.

Leadbeater (2004) argues that in the age of digital technology, students perceive learning as a personalised contextual activity. This is due in part to ever evolving technologies which provide personalised and limitless applications. Winters (2007) posits that a learning activity through mobile learning happens when the learner is mobile, and not fixed in a predetermined location, and hence a learner takes advantage of his learning environment (context) and space for learning and the opportunities offered by mobile devices. Geddes (2004) describes mobile learning as acquiring knowledge using mobile devices, in a contextual environment that often alters a learner's behaviour.

This study recognizes context as the key component of research. Furthermore, the discrete nature of a program attempts to identify two major contexts of a university as the basis of study and comparison. This thesis will compare two groups - the College of Engineering (CX1) and the College of Education (CX2) from one university. They are chosen according to the contrasting differences in their programs, curriculum, pedagogy, student aptitudes, required skills, and lengths of study, to name a few. Commonalities and differences between these two contexts will provide further data on acceptance processes. The use of the UTAUT2 model will provide the current research with the ability to contrast its findings with those of past studies and also evaluate the evidence across those studies. Given that mobile learning is highly flexible, the findings should be applicable across a range of similar context programs.

1.5.1 New Zealand Context

According to the latest census results released by Statistics New Zealand in 2013, New Zealanders have become increasingly mobile: the total number of mobile phones owned in New Zealand was five million in 2013 whilst the total population of New Zealand itself still numbered around 4.4 million at the time (Herald, 2013). In another study published by Nielsen New Zealand Connected Consumers Report, about 65% of New Zealanders access the internet via a Smartphone each week (Research New Zealand, 2015). Verkerk (2014) predicts that by 2018, 90% of the population of New Zealand will own a Smartphone.

The New Zealand government plans to provide ultrafast wireless broadband to 97.7 % of schools and 99.9 % of their students by 2016 (Ministry of Business, 2012). According to Puley (2011), most on-campus Smartphone users prefer to connect with their institution's Wi-Fi hotspots and utilise the free bandwidth. This provides universities and educational institutions an advantage to promote, deliver and better manage teaching and learning. All of these facilities depend upon the fact that Smartphones offer ready access to the Internet.

As noted earlier, there are many advantages to using Smartphones in the field of education. In New Zealand, in particular, the literature review sighted in this thesis suggests the need to examine learner readiness and the factors governing their use within educational institutions.

1.6 Research Focus

The main focus of this research was to determine the UTUAT2 model's ability to predict the acceptance of the Smartphone as a mobile learning tool within two contexts (colleges) in the same university education system. The seven independent variables of this model are (i) performance expectancy, (ii) effort expectancy, (iii) social influence, (iv) facilitating conditions, (v) hedonic motivation, (vi) price and (vii) habit. In the model, each of these independent variables are assessed in terms of their influence on the dependent variable of behavioural intention to accept a technology. These same seven constructs (modified in two cases) will be used in the current study, as part of the model, to determine their potential influence on the behavioural intention to accept Smartphones.

The UTAUT2 model was chosen as the theoretical basis for this research because it was an empirically validated model that integrated determinants from eight information technology acceptance models. Venkatesh et al. (2012) posit that this model also explained a higher degree of accuracy in describing technology acceptance (up to 70% in user behavioural intention to use the technology) than the other eight prevalent technology acceptance models (Theory of Reasoned Action, Innovation Diffusion Theory, Social Cognitive Theory, Theory of Planned Behaviour, Model of PC Utilization, Motivational Model, Technology Acceptance Model and Combined Technology Acceptance Model).

However, the current work also involved the modification of two of the original independent variables (social influence and facilitating conditions) to make them more relevant to the study of smartphone acceptance. The modification of the social influence construct involved changing the focus from the influence of family, friends and community to a focus on peers, classmates and faculty. These latter groups can be argued to have more important influences on the acceptance of Smartphones as part of the education environment which is the focus of the current work (i.e., a university environment).

This research is further influenced by the Connectivism theory proposed by Siemens (2005), which explains how new technologies can created new opportunities for users to share information and support and create a community of learners. Further the Community of Enquiry framework proposed (Garrison & Arbaugh, 2007) also suggests that activities that cultivate a community of learners in terms of help and support will also enhance the learner's satisfaction. Therefore, modifications were made to a second independent variable, facilitating conditions. This was redefined to focus on aspects of receiving encouragement to use Smartphones from the community of learners with which the student will interact; i.e., fellow classmates, peers and faculty at the university. Furthermore, the original facilitating conditions independent variable was defined as the degree to which an individual believes that help and technical support is provided by the institution (Venkatesh et al., 2012). In the case of this research, the technology (i.e. Smartphone) is owned by the users rather than the university, hence specific support from the institution is unlikely. More likely, is that the student will find support from other owners of Smartphones. Hence, this research replaced the technology support with that of help and support received from classmates and peers.

Researchers in the fields of technology acceptance regularly focus on assessing differences between various groups defined by their backgrounds such as "gender", "age" and "experience" as moderators of the UTAUT2 model (Harsono & Suryana, 2014; Oechslein, Fleischmann, & Hess, 2014; Segura & Thiesse, 2015; Wang, Shen, Novak, & Pan, 2009; Yang, 2013; Yee, 2015). This research also investigated group differences in order to assess the acceptance of the Smartphone as an educational tool. Consistent with previous research, gender (women versus men) was included as a potential moderator by intention to use Smartphones. Given that differences in intentions between men and women have been found with other technologies, there is no reason to believe that the same will not be apparent with Smartphones. However, the unique aspects of Smartphones (such as its increased social-communicative features and its use as a personalised tool) argue for this assumption to be formally tested. Furthermore,

In addition to gender, two relatively new moderators (at least in terms of their use in the UTAUT2 model) were included in the study: these were educational level (undergraduate and postgraduate) and context (college of engineering and college of education). The choice of educational level was based on a detailed literature review which revealed that education level was a better predictor than age in the assessment of technology acceptance in an academic environment (Abu-Shanab, 2011; Agarwal & Prasad, 1999; Al-Gahtani, 2004). Similarly, this research also hypothesised that students from different educational context would accept Smartphones in academia differently, possibly due to their differing background experiences; and, therefore, educational context replaced experience as a moderator in the UTAUT2 model in the current study. This study further recognizes the theory of Connectivism proposed by (Siemens, 2005) as it posits that knowledge is distributed across the social and communication networks in the educational context that the student is situated in. The two contexts chosen (engineering and education colleges) offer the opportunity to compare groups in terms of differing educational programme types, variations in the pedagogies used within those programmes, and contrasts in the educational experiences of the students. These educational contexts also vary in terms of the proportion of females and males enrolled in the programmes, providing the opportunity to investigate interactions between moderators. Hence educational context was adopted as a third moderator along with gender and educational level. Indeed, the arguments posed within the rest of this thesis (based on the ideas briefly noted in the previous two sentences) suggest that educational context may be one of the most important moderators when it comes to considering the adoption of a devise such as a Smartphone. This argument will be discussed further throughout the thesis, but its importance in terms of developing one of the key factors investigated in the current work should be noted.

In order to assess the hypotheses posed within this study, a survey questionnaire was developed based on previous research surveys that have been used in the field of technology acceptance. The current survey questionnaire consisted of four sections. The first section focused on demographic questions, and provided the basis on which to code students according to differences in gender, educational level and college context (the moderators in the study). Information within this section of the questionnaire also provided additional demographic data on the participants for descriptive purposes.

The second section was aimed to find the student’s willingness to use Smartphones for various academic benefits such as downloading educational applications or eBooks, submitting assignments, etc. The third section of the survey questionnaire examined the frequency of the current use of Smartphones for other activities than educational benefits. This section provided data on how students were engaged with Smartphones for various activities, such as checking emails, listening to music, playing video games and watching movies, etc. The results from section two and was expected to give the idea of how intensely the students are engaged with their Smartphone as primary computing, communication and entertainment device.

The fourth section provided the data related to the seven independent variables (performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price and habit) of the UTAUT2 model. The questions in this section were mostly derived from the literature, but with modifications aimed at answering the questions briefly covered above, as well as changes in focus of questions to emphasise Smartphone use.

Although acceptance of Smartphones was considered in terms of its use as an educational learning tool, it should be noted, that this research did not aim to investigate students' learning, their learning experience or knowledge acquisition provided by the use of Smartphones; nor did it aim to contrast the learning produced by Smartphones with other tools that are used in education, or other methods of knowledge acquisition. Its aim was simply to investigate its potential for adoption by students as a learning tool. If students are not willing to adopt the tool, then its use will be limited. Additionally, factors that influence adoption should be considered by organisations that aim to include such a tool in their support of learning. Therefore, the findings of this study should only be viewed as evidence of how research factors influence behaviour intentions to use Smartphones as a learning tool, not as evidence for its effectiveness as a learning tool. The latter question is for studied with a very different focus and design.

Research scope: The scope of this thesis will focus on the perceptions and preferences of students relating to their acceptance of the Smartphone as an m-learning tool. This thesis will only focus on using the Smartphone for mobile learning and exclude other forms of digital learning. The selection of Smartphones was made as they are available to students all the time, hold considerable computing power with an around-the-clock internet connectivity and the ability to interconnect with a wide variety of communication modes.

The choice of the Smartphone as a mobile learning tool for research is also based on its ability to enable peer-to-peer sharing, networking, wireless connectivity, internet access, text messaging, video capturing, voice calling and its content creation ability. Moustakas and Oliveira (2012) claims that apart from providing free and open source software applications, Smartphones can create a positive impact on the learning process by collaboration, interaction and teamwork as well as by improving faculty and student communication.

They also offer multiple possibilities such as augmenting reality, reading eBooks, geolocation services, internal-sensors based learning applications, imaging, access to media (audio/video), podcasts, notifications, internet browsing, short and long range communication, text messages and other easy interactions which no other mobile devices can ensure. Hence, Smartphones are ideally suited for providing formal, informal and blended learning content more easily than other mobile devices.

1.7 Research Question

The principal aim of this thesis is to measure the acceptance of Smartphone technology in a university environment. As noted earlier, this thesis examines the responses of two different groups of students: CX1 and CX2. This thesis uses the UTAUT2 model and focuses on the following variables; performance expectancy, effect expectancy, social influence, facilitating conditions, hedonic motivation, price value and habit. These variables were chosen because they have a direct impact upon behaviour intent. The model was modified to incorporate two new moderating factors: context (CX1 and CX2), and the level of education (Undergraduate, Postgraduate and PhD, hereafter referred to in short as UG, PG, and PhD respectively), along with the existing gender moderator (Men and Women). This thesis was guided by four research questions as outlined below:

1.7.1 Research Question 1:

Are the UTAUT2 independent variables significant predictors of the behaviour intention to accept Smartphones as mobile learning tools?

The primary focus of this study will assess all the seven constructs of UTAUT2 models as significant predictors of behaviour intention (BI) towards accepting the Smartphone as a mobile learning tool. These seven constructs are listed below:

1. Performance Expectancy (BI ← PE)
2. Effort Expectancy (BI ← EE)
3. Social Influence (BI ← SI)
4. Facilitating Conditions (BI ← FC)
5. Hedonic Motivation (BI ← HM)
6. Price Value (BI ← PV)
7. Habit (BI ← HB)

1.7.2 Research Question 2:

Is there any statistical difference due to either gender or educational level on the behavioural intention to use Smartphones as mobile learning tools?

The UTAUT2 model, apart from assessing the seven constructs' influence on behaviour intention to use technology, predicts the effect of moderators. This thesis will also assess the effect of gender as a primary moderator. Bem (1981) proposed the Gender Schema Theory which posits that an individual's gender (Men or Women) affects their cognitive structure (a neural network of connections which guides the individual's perception). Gender remains the primary moderator in many studies which use the UTAUT2 model to assesses the acceptance of technology (Admiraal, Lockhorst, Smit, & Weijers, 2013; Alrawashdeh, Muhairat, & Alqatawnah, 2012; Fehrenbacher, 2013; Slade, Williams, & Dwivdei, 2013; Venkatesh et al., 2012; Xu, 2014; Yang, 2013).

There are many studies in the field of technology acceptance which have incorporated educational levels (AlAwadhi & Morris, 2008; Foon & Fah, 2011; Jairak, Praneetpolgrang,

& Mekhabunchakij, 2009; Jaradat & Al Rababaa, 2013; Oshlyansky, Cairns, & Thimbleby, 2007; Yap & Hii, 2009). These studies suggest that education level is a significant moderator that influences the behaviour intention to use technology.

Hence, the second question will investigate gender and educational levels as moderating factors in the integration of Smartphone technologies. More specifically this thesis asks,

1. How does Smartphone acceptance compare with gender as a moderator on the total population?
    a. Gender CX1+CX2 (M:W)
2. How does Smartphone acceptance compare with educational level as a moderator on the total population?
    a. Educational Level CX1+CX2 (UG:PG)

1.7.3 Research Question 3:

Is there any statistical difference in the <u>inter</u> gender and the <u>inter</u> educational level, within each of the two contexts, on their behavioural intention to use Smartphones as mobile learning tools?

This thesis investigates the impact of context by surveying students from two distinct contexts; The College of Engineering (CX1) and The College of Education (CX2), at a University in New Zealand.

To burrow deeper into a more comprehensive understanding of the effects of context, the third set of research questions analyse the effect of gender (M:W) and educational level (UG:PG) in the two contexts independently, a practice here termed as inter contextual moderation. Such comparing and contrasting of the effects of gender and educational level will help in a better judgement of similarities or differences at a contextual level, and thus this thesis asks,

1. How does Smartphone acceptance compare across the two contexts?
    a. Context: (CX1:CX2)

2. How does Smartphone acceptance compare across the two contexts with gender as a moderator?
    a. Gender: CX1(M:W) : CX2(M:W)
3. How does Smartphone acceptance compare across the two contexts with educational level as a moderator?
    a. Educational Level: CX1(UG:PG):CX2(UG:PG)

1.7.4 Research Question 4:

Is there any statistical difference in the intra gender and the intra educational level, between the two contexts, on the behavioural intention to use Smartphones as mobile learning tools?

Smartphone technologies have liberated learners from cabled connections and have permitted access to knowledge without limiting the need to sit in a fixed location or at a computer (Moustakas & Oliveira, 2012). As a result of these features, context as a moderator assumes greater importance.

The two contexts of this research are academically different (different literacies, learning activities, academic tasks, course assessments, program schedules and curriculum syllabi). This research had chosen to assess two discreetly different educational contexts to compare and contrast the effect of Smartphone acceptance for education. The main assumption of this study is that the acceptance of Smartphone for education differs contextually. Hence a deeper intra contextual comparison will aid in confirming the assumption of this research.

1. How does Smartphone acceptance compare across the two contexts for the same gender moderator group?
    a. CX1(M):CX2(M): Comparison of Men (gender moderator) acceptance across the two contexts
    b. CX1(W):CX2(W): Comparison of Women (gender moderator) acceptance across the two contexts

2. How does Smartphone acceptance compare across the two contexts for the same educational level moderator group?
    a. CX1(UG):CX2(UG): Comparison of undergraduate (educational level moderator) acceptance across the two contexts
    b. CX1(PG):CX2(PG): Comparison of postgraduate (educational level moderator) acceptance across the two contexts

1.8 Research Method and Data Collection

This research is primarily deductive by the nature of its research questions. According to Lavrakas (2008), a deductive research adopts a theory as the basis for its research. Furthermore, the framework of deductive research formulates sets of hypotheses based on the theory adopted and tests the relationships and differences after collecting numeric survey data. The data is collected after designing and testing the survey instrument and is assessed using statistical methods. Results are concluded about the phenomena and the formulated sets of hypotheses are either accepted or rejected. Previous literature posits that, a quantitative research manipulates key factors and attempts to investigate the relationship between the variables after data collection (Cohen, Manion, & Morrison, 2013; Lavrakas, 2008). The aim of this study is to assess the significance of the UTAUT2 model to evaluate the acceptance of smartphones as a mobile learning tool by contextual comparison of two cohorts of the same university (College of Engineering and College of Education). The researcher selected UTAUT2 model after the review of literature which is a powerful predicting framework which can effectively explain and analyse the technology acceptance behaviour of users than its predecessor models. However, modification were made to increases its relevance in this study by adding two new constructs: Social Influence and Facilitating Condition and the addition of the Context of education as a moderator.

To achieve this aim, the quantitative study adapted in this research followed a five stage statistical assessment after reviewing forty published research articles in the field of technology acceptance. Mentioned below are the stages followed in order to answer the research questions of this study.

1. Instrument design stage
2. Data collection stage
3. Principal Component Analysis (PCA) stage
4. Confirmatory Factor Analysis (CFA) stage
5. Hypothesis Testing stage

In this study the instrument design stage developed the survey instrument after a pilot test, and the data collection stage defined the distribution and collection of the survey both digitally and in a paper based format. The Principal Component Analysis stage focusses on identifying the right set of items from the survey which best explain the shared variance between the seven independent constructs and the behaviour intention (the dependent constructs). This stage also assesses the reliability of the extracted variables. The next stage which is the Confirmatory Factor Analysis, at first checks the sample adequacy of the extracted set of variables from the PCA stage. The CFA also checks the “goodness of fit” or “model fit” indices, which should confirm the extracted variables as fit to proceed for conducting Structural Equation Modeling (SEM). The last stage tests the relationships between the models and the variables and then ascertains a hypothesis’ retention or rejection.

The data will be obtained through a questionnaire survey from a university in New Zealand in which engineering and teacher education are taught; thereby providing a large sample of students to obtain data. The sample will comprise of all enrolled students within the two contexts at the time of this research who agreed to participate and to whom access is obtained. Opportunity sampling techniques will be used to access students, based on the researcher’s knowledge, past experiences and support from faculty. The University’s ethical procedures for contacting students and requesting participation will be followed at all times.

1.9 Research Significance

This research contributes significantly to existing bodies of knowledge by providing additional constructs and moderators to an existing model of technology acceptance. The newly modified model was used to investigate the acceptance of Smartphone-based mobile learning. The following outcomes were derived from the work.

By identifying the key components from this research on how students accept Smartphones for education and how context, gender and educational differences affect these choices, universities and similar institutions will be better able to integrate Smartphones-based mobile learning programs.

Such a comparison of two potentially diverse study areas, engineering and teacher education, has not previously been explored in relation to the adoption of Smartphones as educational tools. However, rapid changes in mobile technology consequently affect m-learning; this necessitates a consistent understanding of ways to deploy Smartphones for optimum anytime-anywhere learning.

The comparison of two educational contexts will increase our understanding of technology integration. The research is also significant in that, to the researcher's knowledge, such a comparison has not been attempted before in a technology acceptance study. The comparison of the two contexts targeted within this study is expected to give a broad perspective in identifying the fundamental parameters which dictate the context based adoption of mobile devices. This study will help universities and similar institutions to focus on a customized integration and gradual migration to a mobile learning environment.

In the year 2014, mobile internet overtook desktop internet usage (Perez, 2014). Furthermore, it is estimated that by 2017, 87% of the connected devices in the world will be Smartphones (Columbus, 2013). This thesis will contribute significantly in understanding the ubiquity of Smartphones devices in education through acceptance data, facts and figures.

According to the Life Marketing Monitor website, 60% of adults in New Zealand own Smartphones (Carney, 2013). As noted earlier, the New Zealand government plans to make ultrafast wireless broadband available to 97.7% of schools and 99.9% of students by

2016. The research findings can be used to inform such plans and should be applicable to other education providers in New Zealand.

1.10 Research Organization

The first chapter introduces the study with a brief research background, research significance, research question, and research scope. The second chapter mainly discusses the literature review concerning this study. The Review of Literature will introduce the topics of technology, the importance of technology acceptance, technology integration, and technology acceptance. A section of this chapter also highlights the concept of mobile learning, and subsequently discusses the origin of the Smartphone as a mobile learning tool and its significance in relation to this study.

The third chapter focuses on the methodology followed in this research. This section will describe the design methodology followed in the research, instrument development, validation techniques, participants and conclude with the administration of the survey.

The fourth chapter Hypothesis discusses the development and selection of the research model and development hypothesis. The fifth chapter Results describes all statistical results, the analysis and the following section explains the descriptive statistics and the inferential statistics in detail. The sixth chapter Discussion completes the finding of the research, discusses the hypothesis approvals and summarises all four set hypotheses results and their interpretations. The seventh and final chapter presents the research contributions and concludes with suggestions for the future research and limitations of this study.

Chapter 2

2.0 Literature Review

2.1 Introduction

The beginning of this chapter defines technology and educational technology and then proceeds to expand on the purpose behind studying technology acceptance and integration. The next part of this chapter examines mobile learning and the prevailing mobile learning model and frameworks. The discussion will proceed to describe the Smartphone as a mobile learning tool and its evolution in the academic system as well as how it differs from other learning paradigms. This section of the chapter will further outline mobile learning stakeholders, their roles and the challenges in using this device for education.

This chapter will conclude by describing the meta-analysis conducted in this research. The meta-analysis was done after careful selection of research studies from the field of technology acceptance and technology integration. A greater focus was paid on selecting research studies which are current and relevant.

2.2 Technology

Technology is crafted and developed by humans in order to successfully thrive in any environment. The Oxford Dictionary describes technology as “Scientific knowledge used in practical ways in industry, for example in designing new machines” (Oni, 2012, p. 488).

Technology is usually envisioned in terms of computers and specialised gadgetry. But technology is any tool, device or designed system that helps people ease their lives and thrive. Technology includes any device; from pens, paper, wheels, screwdrivers to laptops and Smartphones.

The use of technology was and is the primary source of development for mankind. Advances in technology have crafted changes in human social and economic behaviour; they have allowed people to explore, access and utilize the world around them, thus expanding civilizations.

In the contemporary world, technology overwhelmingly surrounds us in our daily lives. But despite its extensive range in entertainment, communication, healthcare, education etc., technology is often still perceived in the context of electronic devices. Hence, specifically defining technology is a difficult proposition as it can broadly range from the simplest design of a needle to the highly complex construction of a space shuttle.

The complexity of defining technology can be understood from the three varying definitions of technology illustrated by (Jaak, Yassushi, Takehiro, Hannu, & Naofumi, 2003, p. 151)

> *"The practical application of knowledge especially in a particular area (Engineering)".*
>
> *"A manner of accomplishing a task especially using technical processes, methods, or knowledge (new technologies for information storage)".*
>
> *'The specialized aspects of a particular field of endeavour (Educational technology)".*

2.3 Technology Life Cycle:

A Technology life cycle describes the origin or trigger of a technology, followed by its diffusion and acceptance, succeeded by its eventual maturity and decline. A comprehensive understanding of the technology cycle aids in an effective estimation of technology and an accurate reading of its cost and value benefits. This understanding of the technology life cycle can help businesses and institutions forecast the branching of subsidiary or secondary technologies. For instance, the birth of email technology has led to the surge of texting and social networking which has engaged the world of communication. This in turn has led to the redefining of communication models, freedom of speech, the way business is conducted and has made the world realise the power of crowd sourcing. Corresponding to product life cycles as well, a good understanding of technology life cycles can benefit users in differentiating the introduction, growth, maturity and decline of a particular technology (Haupt, Kloyer, & Lange, 2007). A technology life cycle is divided into four stages: research, ascent, maturity and decline as shown in the Figure 1.

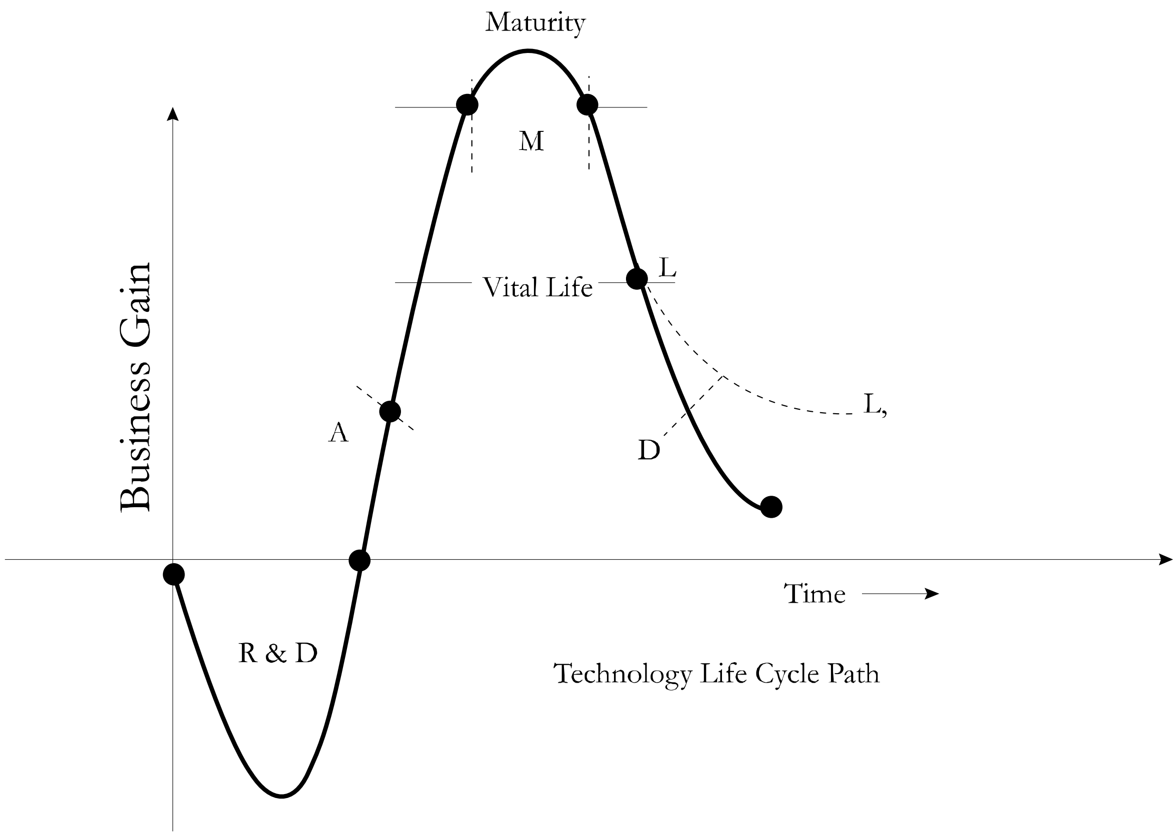

Figure 1: Stages in the technological life cycle (Haupt et al., 2007).

Research and Development Phase (R&D): This stage defines the investment in technological innovations and the conducting of research and development after identifying the most promising technology or innovation.

Ascent Phase (A): This phase defines the rapid growth of the technology where users take advantage of the uniqueness and novelty of technology.

Maturity Phase (M): This stage focusses on the goal of making a technology reach the masses and getting it accepted by the general population.

Decline Phase (D): The last phase describes the utility and potential value of a technology when it has reached its full potential and when its use begins to dip. This decline is often accompanied by a new challenging technology which will claim to offer a better alternative with a bigger capability for a lesser cost.

2.4 Technology Diffusion:

The Diffusion of Innovations is a fundamentally different methodology in proposing the theory of technology or innovation dissemination (Yates, 2001). In this theory, an innovation, adopted by users, is influenced by four factors (Rogers, 2002). These four factors include:

1. The innovation itself
2. Communication channels
3. Time
4. The Nature of the user

This theory focuses on the change itself rather than changing the user behaviour. It further explains as to why certain innovations spread more quickly than others. According to this theory there are five types of people that determine the success of an innovation on their tendency to adopt a specific innovation. As shown in Figure 2, the five categories of people are innovators, early adopters, early majorities, late majorities and laggards (Rogers, 2002).

1. **Innovators:** The adoption process begins with a tiny number of visionary and imaginative innovators who use creativity in developing new ideas and gadgets.
2. **Early adopters:** They perceive the apparent benefits of a technology by observing the innovators who use it, and then they join in themselves. They strategically connect innovations to their personal needs.
3. **Early majority:** Early majority users act only when the use of a technology is supported with empirical evidence, proof or apparent tested benefits. They are influenced by industry standards and endorsements from respectable organizations. When any innovation or technology surpasses this behaviour, it eventually reaches the next group, i.e the majority user.

4. **Late majority:** They are traditional and conservative users who are resistant to change and risk, and are therefore uncomfortable towards the use of new ideas. They are influenced by the opinions of laggards.
5. **Laggards:** Laggards are users that perceive high risks in adopting a particular new product or behaviour and are the most resistant to change. Many times the new technology may not influence them to adopt it.

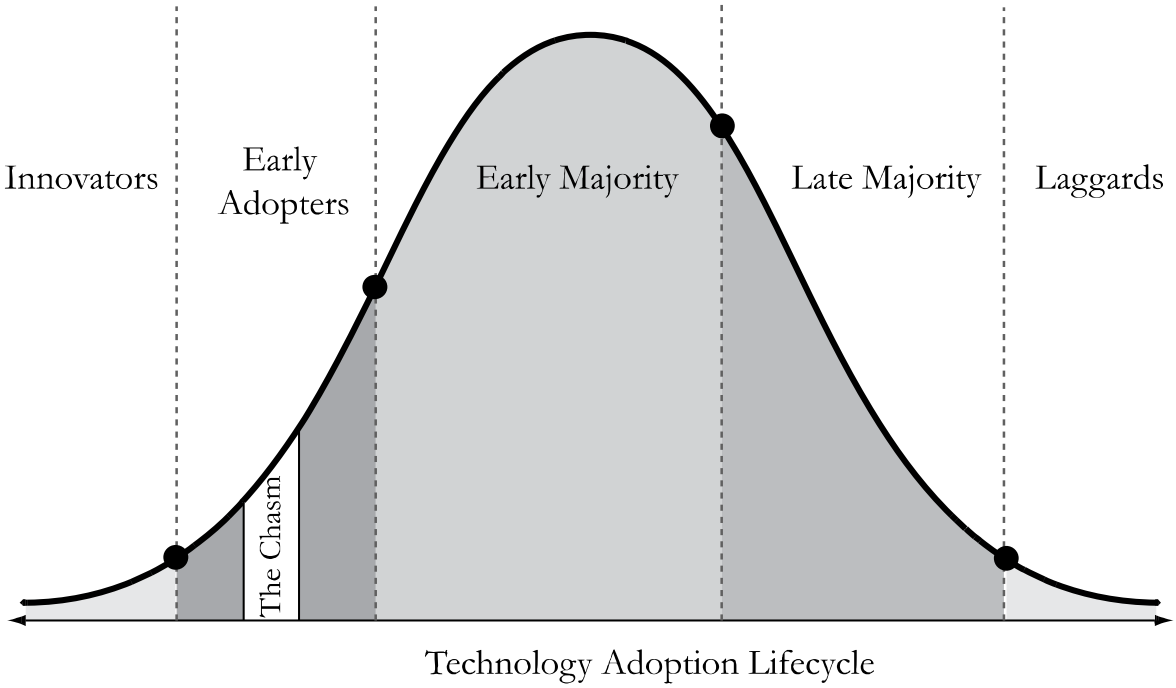

Figure 2: Diffusion of Innovation (Rogers, 2002)

2.5 Technology Hype Cycle:

The Technology Hype Cycle is a graphical representation that best describes a life cycle of a technology. The Hype Cycle illustrates the growth of a technology from its conception to its maturity and widespread adoption. This theory was developed by "Gartner" a market research consultant in the year 1995 (O'Leary, 2008). Gartner Hype Cycle stages are often analysed in the corporate world: they identify how different technologies move with varied paces through the hype curve.

The main advantage of this curve is to understand and characterize the typical progression of an emerging technology (Linden & Fenn, 2003). This understanding is expected to aid in making strategic decisions as each stage of the cycle is associated with its own risks and opportunities (O'Leary, 2008). The hype cycle stages are divided into five phases, Technology Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment and Plateau of Productivity, as illustrated in Figure 3.

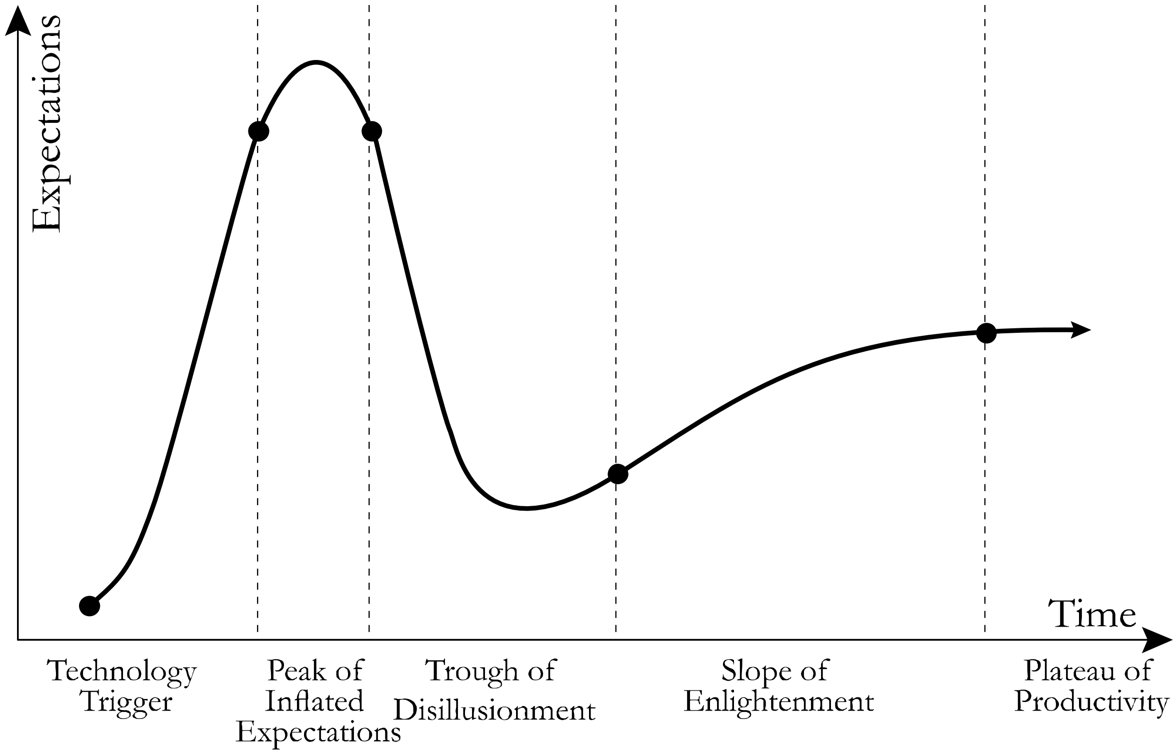

Figure 3: Gartner Hype Cycle (O'Leary, 2008)

1. **Technology Trigger:** In this stage, a technology is conceptualized, triggering public and investment interest.
2. **Peak of Inflated Expectations:** This stage illustrates the implementation of technology by early adopters, resulting in technology hype and publicity about both successful and unsuccessful acceptance.
3. **Trough of Disillusionment:** The rapid spread of a new innovation or technology often results in flaws and failures that may lead to some disappointment in the spread of technology, leading to unsuccessful further development. This may lead to a drop in the advancement of technology, or may continue on after investments in addressing its improvement or refinement.

4. **Slope of Enlightenment:** The potential of technology's future applications becomes more clear and apparent and the technology is understood, resulting in its successful application and further development of products.
5. **Plateau of Productivity:** The technology becomes widely accepted and is well understood. A successful technology which reaches this stage is mature enough to inspire more reasonable expectations, regaining a strong confidence in its future growth.

2.6 Technology Integration

Technology integration is termed as the use of technology resources that becomes a regular practice and is transparent, accessible and readily available for the task at hand (Harris, Mishra, & Koehler, 2009). A successful technology integration eliminates the barriers between itself and the user. The technology's ease of use, usability and functionality become second nature and different technologies foster different ways of thinking (Koehler, Yadav, Phillips, & Cavazos-Kottke, 2005). It can also be explained as a user's experience with a particular technology, when more actively engaged with it, results in a seamless learning process and often results in technology addiction.

In the last thirty years, there has been a large number of innovative technologies that have their effective use in education; this widespread use has motivated researchers to conduct studies in the integration of technologies with education (Lowther, Inan, Daniel Strahl, & Ross, 2008). Becker and Riel (1999) posit that many of the articles published in this research domain have recommended strategies to eliminate barriers between learners and educators. In a study conducted by Turnbull (2002) evaluating the New Zealand Curriculum, it was highlighted that there was obvious confusion among teachers in understanding the aspects of technology integration in academics. With New Zealand adapting technology education as one of the eight core mandatory learning areas, studying technology integration is now critical to its implementation and success.

There are many models and frameworks which define educational technology and its integration and acceptance. The next section of this chapter describes the most popular models and frameworks in the field of technology integration.

2.7 Educational Technology

Educational technology is defined as the use of any tools or technologies which aid and support the effectiveness of teaching and learning. Similar to the holistic definition of technology, educational technology is a comprehensive term on the broad use of tools, technologies and the theoretical foundations for supporting learning and teaching. There are many varied explanations and definitions of educational technologies. According to Januszewski and Molenda (2013, p. 255).

> *"Educational technology is the effective use of technological tools in learning. As a concept, it concerns an array of tools, such as media, machines and networking hardware, as well as considering underlying theoretical perspectives for their effective application."*

Clark (2010, p. 13), supports the definition illustrated by The Association for Educational Communications and Technology (AECT) denoted instructional technology as

> *"The theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning."*

> *Educational technology, sometimes termed EdTech, is the area of technology that deals with facilitating e-learning, which is the learning and improving of performance by creating, using and managing appropriate technological processes and resources.*

There are many studies conducted in the domain of education which have established the fact that learning is enhanced through the use of technology (Behind, 2001).

Educational technology is not only the use of high end technologies like digital interactive white boards, overhead projections, e-learning management systems, Smartphones, virtual reality glasses animation, etc., but it also includes applications and processes such as radio, audio, video, satellite TV and CD-ROM, etc. e-learning includes the digitization of educational legacy content as well as the development of new online content and delivery methods. The variety and frequent use of electronic educational technology has made it an important part of every academic level, from K12 to tertiary education.

The demand, use and potential of e-learning has given rise to distance learning, blended learning and online learning. But with mobile devices proliferating among the majority of the population, mobile learning has emerged as a new disruptive technology. As stated earlier using mobile phones for education, especially Smartphones, takes advantage of their ability to be connected 24/7, their large number of available applications, built in sensors and touch screen functionality.

The successful integration of educational technologies and pedagogies with educational content has always been a challenge at all levels of academia. The essence derived from the above mentioned definition of Educational Technology can be summed up to include any electronic or mechanical tool, piece, equipment or device that can be used to help students accomplish specified learning goals (Davies, Sprague, & New, 2008).

Mishra and Koehler (2006) claim that there is a consistent tendency to only look at the technology and not how it is used. This is often carried out by merely introducing technology to the educational process and not for enforcing its effective use. Furthermore, this research claims that teachers today are not well informed or knowledgeable enough to appropriately integrate technology into their teaching (Knezek, 2003). The primary focus should be on studying how the technology is used.

Burgess-Limerick, Abernethy, and Neal (1993) argue that all methods are limited and so must be critically examined for their appropriateness. This research asserts the importance of critically analysing the technology integration in order to successfully integrate technology into instructional situations.

According to the online New Zealand curriculum, the definition of technology is illustrated as follows: (Owen-Jackson, 2015, p. 9)

> *“Technology is intervention by design: the use of practical and intellectual resources to develop products and systems (technological outcomes) that expand human possibilities by addressing needs and realising opportunities. Adaptation and innovation are at the heart of technological practice. Quality outcomes result from thinking and practices that are informed, critical, and creative.”*

The extensive progression of mobile devices and the dynamic, vibrant use of mobile devices in education have also continually evolved the description of mobile learning to include the following definitions (Keengwe, 2014, p. 99).

> *"The exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning."*

> *"Mobile learning, or m-learning, can be any educational interaction delivered through mobile technology and accessed at a student's convenience from any location."*

2.8 Educational Technology Integration:

Technology integration can be successful when usage of technology becomes second nature and when technology tools become a seamless part of the user's learning process. The National Educational Technology Standards for Students, International Society for Technology in Education defines Educational Technology Integration (Brian & Linda, 2014, p. 94).

> *"Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyse and synthesize the information, and present it*

professionally. The technology should become an integral part of how the classroom functions -- as accessible as all other classroom tools."

Furthermore, a technology can be claimed to be successful when the use of technology is also routine and transparent (Edutopia, 2007). A well-integrated technology should also demonstrate that it is accessible and readily available to help the learners to effectively reach their goals (Mishra & Koehler, 2006). As a technology rapidly evolves and becomes continuously rampant, it demands continual learning.

Educational Technology Integration is vital for today's students. The current generation is labelled "digital natives" as they were born in the era of a variety of digital devices, systems and information technology web 2.0 tools (Prensky, 2001). Such systems have given birth to open source and free to use tools which allow students to create, collaborate and share content online. These, coupled with the power of social networking, blogging, wikis and forums help make students more adaptive and dynamic learners (Kivunja, 2014). Thus, a well-integrated educational technology can make a difference in their learning and prepare students for a future workforce with skills which are more relevant and reliant. Such a successful integrated technology can also extend learning in powerful ways by providing

1. students and instructors with up-to-date content,
2. better class management and data recording,
3. effective collaboration between students, teachers and experts around the world
4. opportunities for expressing awareness via multimedia
5. learning that is relevant and assessment that is authentic
6. training for publishing and presenting their new knowledge

The portability, size and computing power of devices like Smartphones, iPods, Amazon Kindles etc. has given students access to learning content anytime, anywhere. With this new found ubiquity of their personal communication and entertainment devices, students today expect and rely on a much more complex schema to find and collect knowledge (Herrington, Herrington, Mantei, Olney, & Ferry, 2009).

The rampant proliferation of communication technologies have made them affordable. Users have become addicted and expect seamless services at public places like hotels, airports, universities etc. These users get frustrated if the wireless connection is not instantly available. This ubiquitous wireless connectivity has made learners dependent on technology. Furthermore the rapid use of social networking tools like YouTube, Google, Facebook, Twitter etc. by learners has granted them unprecedented access to visual and verbal learning.

The use of cloud, social networks (YouTube, Facebook and Twitter etc.), mobile computing, and big data also empower learners to develop innovative learning techniques and habits. These digital educational technologies enrich face-to-face learning and enable learning to become personalized. Well integrated educational technologies also help to generate data that can help in creating Predictive analytics; thus facilitating educational institutions and instructors to track progress and anticipate areas for development, as well as adapt programs to improve learning (Fulantelli, Taibi, & Arrigo, 2013).

The rapid proliferation of these technologies has improved teaching methods by opening gates to new pedagogies, collaborative learning, social learning, distance learning etc., (Kirkwood & Price, 2006). Learning content is now more accessible in real time providing academia with opportunities to shift from simply transferring knowledge to students to providing them with access to the latest knowledge. Hence it has become more important to successfully integrate new technologies along with their new pedagogies. This is expected to give birth to new models of teaching and learning, new ways and methods of collaboration and engagement between learners and instructors (Herrington et al., 2009).

A rapidly evolving world of technologies, throws a bigger challenge for technology integration (Edutopia, 2007). A few of prominent methods and paradigms of technology integration are listed below after a report published by Edutopia (2007).

1. Online Learning: Students can study at their own pace by utilising **Online** courses delivered over the Internet

2. Blended Classrooms: A method that combines online learning with traditional classroom methods and independent study to create a new **hybrid teaching**
3. Project-Based Learning: Students collaborate on projects that require critical thinking, creativity and communication to answer challenging questions or solve complex problems.
4. Game-Based Learning and Assessment: This type of learning deals with games and applications that have defined learning outcomes. Generally they are designed in order to balance the subject matter with gameplay, and the ability of the player to retain and apply the given subject matter to the real world.
5. Deeper Learning: This is a method of engaging students with rich core content and to find innovative ways that allow them to **learn** and then apply what they have learned.
6. Problem Based Learning: This teaching method uses a student's ability to gain knowledge and skills by working for an extended period of time to investigate and respond to a complex question, **problem**, or challenge.
7. Collaborative Learning: This type of learning constructs a cooperation between students, instructors and student groups that attempt to **learn** something together.

2.9 Technology Integration Framework:

There are two commonly used models for technology integration which are known as the SAMR **(Substitution, Augmentation, Modification, Redefinition) model** (see Figure 4) and the TPACK **(Technological Pedagogical Content Knowledge) model** (see Figure 5). While the first model was developed by Puentedura (2012) and describes technology integration through four levels; the second model emphasises the interaction between the three concepts which are related to teaching in a technology enhanced learning environment.

2.10 SAMR Model

Substitution: is often referred to as the "digitizing stage" in which the way of doing the something or an original method is replaced by using a new technology in order to improve instruction and learning. For example, students use computer software instead of paper based activities. **Augmentation:** This stage is when the technology offers an effective tool to perform common tasks. For example, students take assessments using a technology instead of using pencil and paper based assessments. **Modification:** The stage in which significant tasks are redesigned for the common classroom tasks and are being accomplished through the use of technology. For example, common classroom tasks are accomplished by using technology as a support for student centred learning. **Redefinition:** this occurs when the technology has allowed for the creation of new tools and methods that were not possible before. Students use mobile phones to communicate with the instructor.

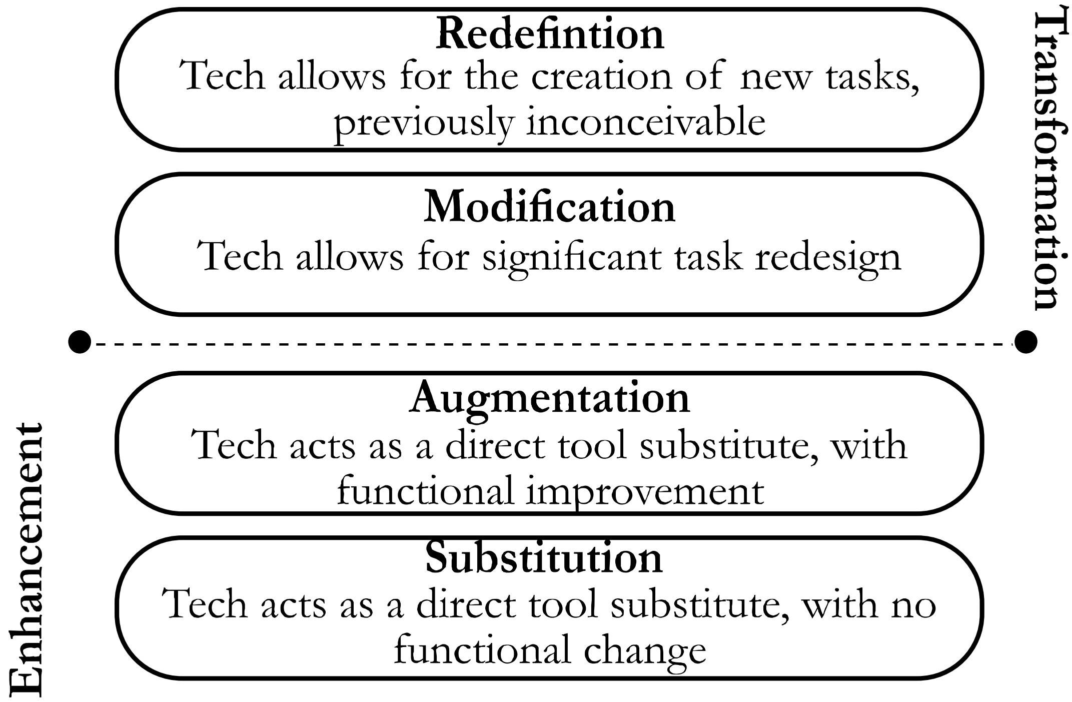

Figure 4: SAMR Model, (Puentedura, 2012)

2.11 TPACK Model

TPACK assumes that effective technology integration requires developing understanding of the dynamic relationship between the components Technology, Pedagogy and Content Knowledge (Koehler & Mishra, 2009). TPACK is the overlapping of three main knowledge areas of technology integration; Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (CK), as shown in Figure 5.

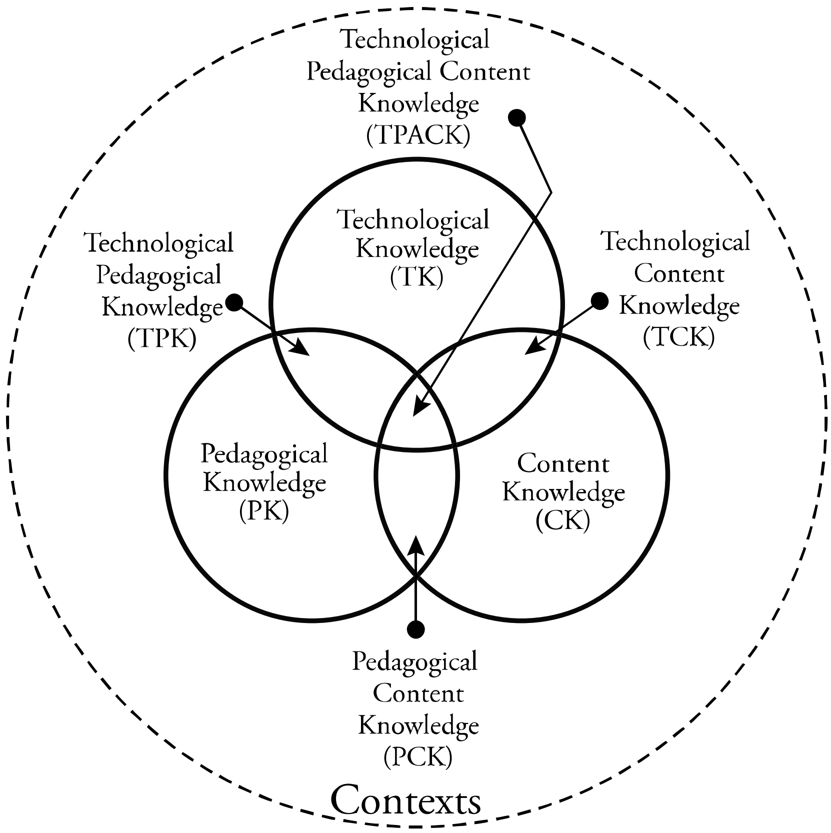

Figure 5: TPACK Model, (Koehler & Mishra, 2009)

1. TCK shown in the Figure 7.0 is the overlap of the Technological and Content Knowledge, which illustrates how technology can contribute content to improve learning.
2. PCK is the overlapping area of Pedagogical and Content Knowledge that describes how content affects the pedagogy for learning
3. TPK is the overlap of Technological and Pedagogical Knowledge that defines how technology works with the pedagogy and how it determines which technology will be appropriate for learning.

The central overlapping area is the product of Technology, Pedagogy, Content and Knowledge known with the acronym TPACK. Both SAMR and TPACK models are basically technology integration frameworks that are limited to an existing technology. They do not predict technology acceptance or technology adoption. Ally (2009, p. 151) illustrates that *"Educators need to exercise mental agility with regard to diverse possible* *uses for a single device"*. This study also highlights that Mobile technologies offer excellent initiative taking opportunities for all educators to explore the possibilities of using them in creative and engaging ways. Both TPACK and SAMR allow educators to think outside the box by using mobile technology and by allowing the learners to connect with learning content (Koehler & Mishra, 2009).

2.12 Mobile Technologies

The term "Mobile Technology" covers a huge range of mobile devices. They are digital, portable, electronic devices used to perform a wide variety of communication, business, productivity and lifestyle tasks; they are also connected through a cellular communication network or a wireless connection (Naismith, Sharples, Vavoula, & Lonsdale, 2004). The common mobile technologies which allow these tasks are cellular phones, Portable Digital Assistants (PDA), handheld computers, tablets, laptops and wearable devices, etc. A standard mobile technology device may have one or more features like a cellular phone, a Geographical Positioning Systems (GPS), a web browser, instant messenger system, audio recorder, audio player, video recorder and gaming system etc. They also transmit a variety of media wirelessly such as sharing electronic media content like photographs, videos and data using radio wave, microwave, infra-red, GPS and Bluetooth media sharing protocols via voice, text, video, barcodes etc. The mobility feature makes this technology revolutionary compared to other information technology devices and applications.

Naismith, Lonsdale, Vavoula, and Sharples (2005) defines mobile technologies from the perspective of their portability. This research divided the four quadrants with the mobile device features "Personal and Shared" on the opposite sides of y-axis and the features of "Portability and Static" on the x-axis, as shown in Figure 6. Such types of classification help in defining the category of a mobile device more competently.

The classification of mobile devices can be done in three categories (according to their transport ability, weight, form, components, capacity and connectivity): transportable devices, mobile devices and wearable devices (Mehdipour & Zerehkafi, 2013). Among mobile technologies, Smartphones and tablets have dominated the communication and computing landscape. Smartphones are poised to lead mobile computing along with tablets (Adobe, 2013). This report claims that "Internet users view 70% more pages per visit when browsing on a tablet and Smartphone (Adobe, 2013).

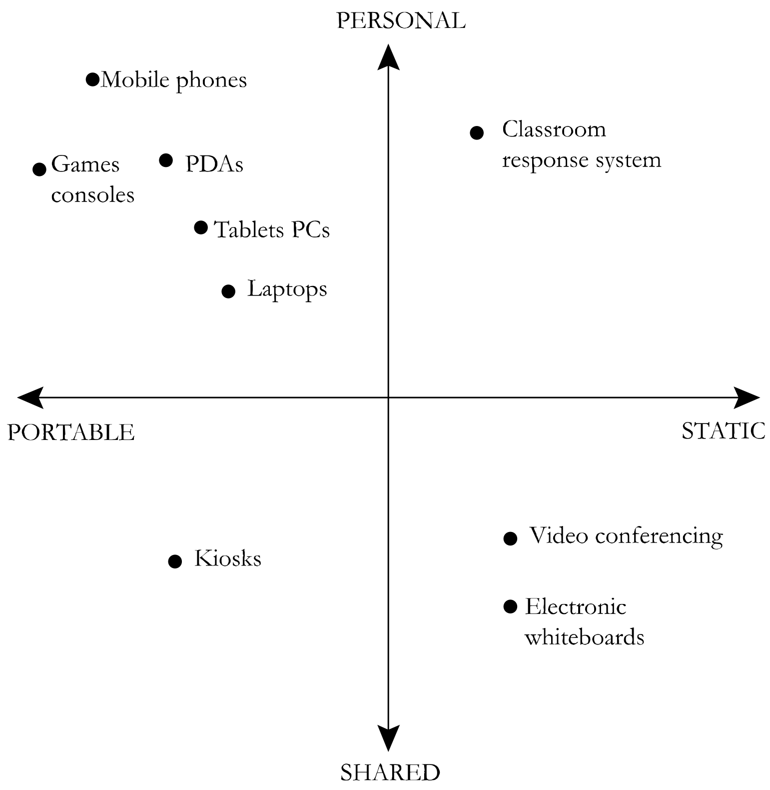

Figure 6: Mobile technologies classification (Naismith et al., 2005)

The advancement of Smartphones and tablets has resulted in sweeping changes in the social, professional, educational and economic lifestyles of people, giving rise to ubiquitous computing (El-Hussein & Cronje, 2010). The use of mobile devices has given shy students a voice in order for their questions to be heard and has allowed them to collaborate with peers as well as expand their knowledge with other resources available on the internet with very little cost and effort. Thus, learners gain access to knowledge, information, teamwork and experience sharing in real time. This was not possible in a face to face classroom setting. These devices have tremendous potential and present opportunities for educators to enable and deliver learning in ways that could not previously have been accomplished (Istanbullu, 2008)

Most mobile technologies are underused by today's generation, beyond the use of e-mail, entertainment, web browsing or playing games. Mobile technologies have been largely dormant as tools for teaching and learning (Perry, Hutchinson, & Thauberger, 2007). Perry et al. (2007) report that more than 50% of university students agreed that they spend most of the time sending messages, chatting and browsing internet with their mobile devices. This study also highlights that interactive, synchronous mobile technology has a behavioural control and becomes a habit with the students. The average student spends 50 minutes for e-mailing, 25 minutes in chatting, around 1 hour 20 minutes of daily interactive communication and 92 minutes using the World Wide Web browsing. Notwithstanding this addictive behaviour, mobile devices retain the potential to become machines of teaching and learning, similar to the way the World Wide Web (www) became the backbone of learning during the era of personal computers and information technology (Owston, 1997). This research also claims that the World Wide Web can free teaching and learning from the physical spaces of classrooms, which are often time and scheduled bounded. Traditional lectures can leverage the web based media as a learning resource which can help the universities, institutions and colleges refocus from teaching to learning and from teacher to student.

2.13 Mobile Learning

Mobile learning (m-learning) is the expansion of e-learning. M-learning differs from e-learning as shown in the table 1.0 (Mehdipour & Zerehkafi, 2013). The content, knowledge and information are accessed by means of wireless networks, mobile networks and mobile technologies. There are many definitions of mobile learning, however the leading organisation that have defined it are Advanced Distributed Learning (ADL) (Haag, 2011, p. 3).

> *"The use of handheld computing devices to provide access to learning content and information resources."*

which is a leading organization that has set e-Learning standards, SCORM (Sharable Content Object Reference Mode), EDUCAUSE and eLearning Guild (Wan, 2013, p. 188).

"Mobile learning, or m-learning, can be any educational interaction delivered through mobile technology and accessed at a student's convenience from any location.".

"Any activity that allows individuals to be more productive when consuming, interacting with, or creating information, mediated through a compact digital portable device that the individual carries on a regular basis, has reliable connectivity, and fits in a pocket or purse." in a pocket or purse."

The simplest definition by Naismith et al. (2004) defines that m-learning is a specific type of learning model using mobile technology. Researchers today define m-Learning considering either defining it with new devices, or on the basis of activity theory, adult informal learning theories, or course developments etc. or by relating m-learning with e-learning (Naismith et al., 2004). Mobile learning has been called bitesize, handy learning, ubiquitous, portable, pocketable, learning nuggets or learning pills. It is indeed a notable fact of m-Learning is that it is delivered in small chunks.

One of the main objectives of m-learning is to reach as many learners as possible, whereas e-learning can be conducted real-time or self-paced, also known as "synchronous" or "asynchronous" learning (Smarkola, 2011). Furthermore, e-learning is tethered, linked to source and delivered in a formal and structured manner, at the same time mobile learning is delivered self-paced and un-tethered. The quality of m-learning is dependent on the awareness of the limitations and benefits of mobile devices (Mehdipour & Zerehkafi, 2013). Furthermore, personalization is a key component of m-learning.

2.14 Mobile Learning Types

Nikol, Manu Kapur, Mitchel Nathan, and Puntambekar (2013, p. 280) defined Ubiquitous computing as:

An environment where the computing devices are integral but embedded into the background of daily life.

The concept of ubiquitous learning (u-learning) can be applied to the educational curriculum involving a learning environment where every student has an access to a mobile devices and services, whenever and wherever it is needed (Park, 2011). A typical mobile technology supported learning allows the teacher to remain focused on the body of knowledge while utilizing mobile technology to augment student learning. Although technological tools used for ubiquitous learning can be numerous, Crowe (2007) identified handheld devices as a key component of ubiquitous learning. Figure 7 illustrates the various stages of technology assisted learning migration from e-Learning to u-Learning.

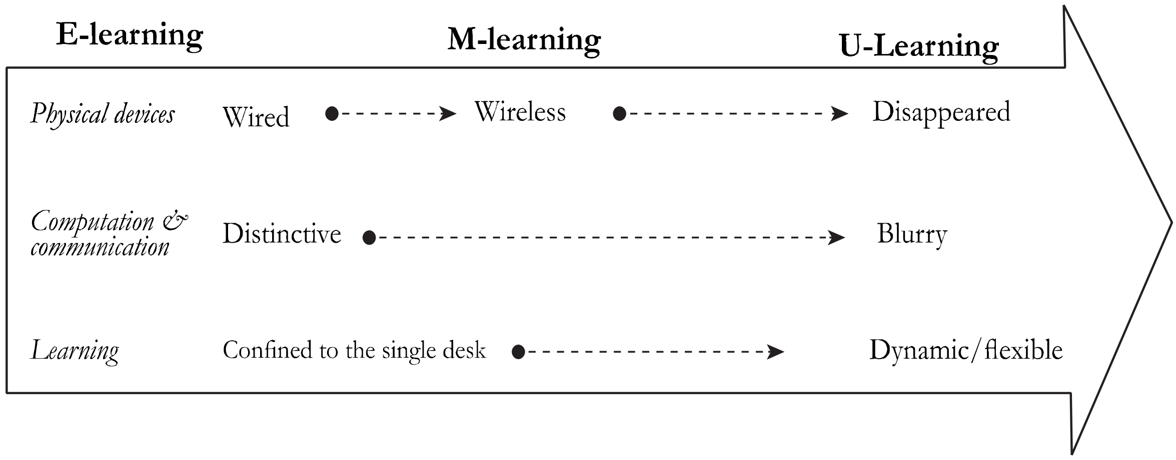

Figure 7: Comparison of e-learning, m-learning and u-learning, (Crow, 2007)

Most mobile technologies and devices are classified by the type of wireless communication technologies the device supports, the portability of the device and the personal usability. Notebooks, Tablets, PDAs, cell phones or Smartphones use GSM, IEEE 802.11, Bluetooth, etc. and wireless communication protocols. Educational mobile technologies are also classified by relating to the supported information and the method of accessing them.

Georgieva, Smrikarov, and Georgiev (2005) added two more classification criteria which are based on the support of e-learning standards and the communication which happens between students and instructors as indicated in Figure 8. The proposed classification is based on the following main indicators:

1. support of synchronous and/or asynchronous education
2. support of e-learning standards
3. availability of permanent Internet connection between the mobile learning system and the users
4. location of the users
5. access to learning materials and/or administrative services

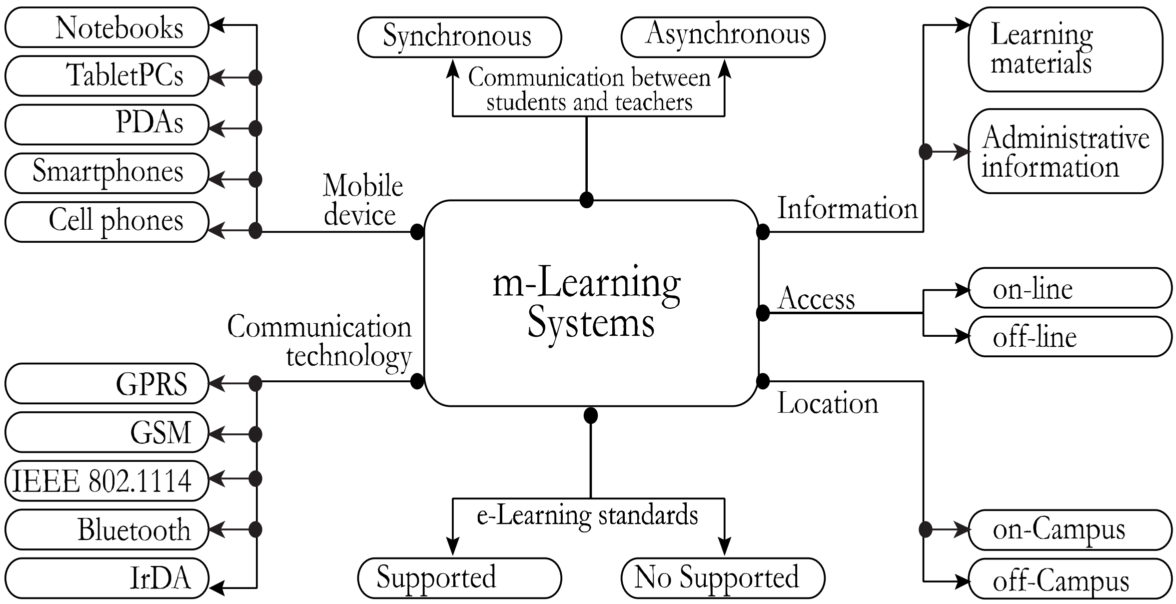

Figure 8: A general classification of m-learning systems, Georgieva, (2005)

This modified classification provides a variety of possibilities to evaluate and realize mobile learning requirements. Furthermore this model is expected to provide access to learning materials and administrative services with dependence on the location of the users and permanent Internet connection availability.

Naismith et al. (2005) illustrate that mobile computing devices foster innovative methods of mobile learning in order for Students to interact with course content, peers and instructors in a variety of ways using mobile devices. Mobile learning technologies facilitate and enable the following: Exponential Learning, Just in time learning, Situational and contextual learning, Flexibility in learning, Mobility in learning, Anytime anywhere, Interactive learning, Personalized learning, Informal learning, Collaborative learning, Social media learning, Reinforce learning, Experiential learning (virtual reality, augmented reality, Near Filed Capability -NFC capability of mobile devices), Element of humanization in learning, Chunked or bite sized learning and Affordable learning (declining prices of Smartphones).

2.15 Mobile Learning Frameworks

There are many models explaining m-learning which can be effectively implemented in both formal and informal settings. Among them, the Framework for the Rational Analysis of Mobile Education (FRAME) model developed by Ally (2009) has gained lot of acceptance. This model adapts the concepts of psychological activity theory (Kaptelinin & Nardi, 2006) in which the mobile device is an active component on equal footing with learning and social processes by placing more emphasis on constructivism. The core aspect of the FRAME model, illustrated in the Venn diagram Figure 9, explains how learners consume the information collectively and individually.

The three circles represent the three domains of m-learning namely, device (D), learner (L), and social (S). The intersection of the device usability (DL) and social technology (DS) describes the affordances of mobile technology. The second union illustrates interaction learning (LS) which embodies instructional and learning theories with an emphasis on social constructivism. All the three overlapping aspects in the centre of the Venn diagram explain primary intersection ideal mobile learning situation (DLS). This model had gained acceptance by many researchers for understanding the development of future mobile devices, the development of learning materials, and the design of teaching and learning strategies for mobile education (Ally, 2009).

The influence and dependence of technology to make the content delivery and management of education irrespective of physical space lead academia to evolve e-learning and online learning (distance learning). In an e-Learning environment, learners are not tethered to physical classrooms or college spaces. With the advent of mobile devices these online delivery systems have delivered learning content into handheld devices, thus causing the paradigm of mobile learning to come into existence.

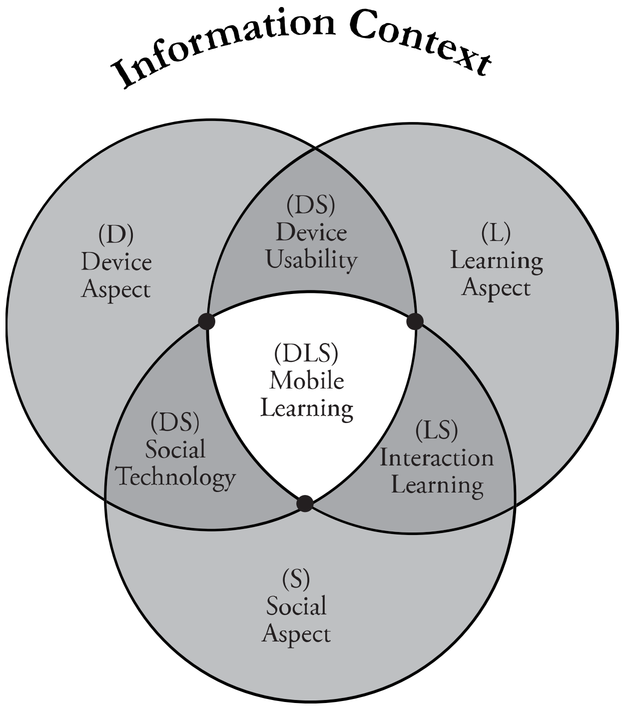

Figure 9: The FRAME Model for explaining m-Learning (Ally, 2009)

Haag (2011) posit that mobile learning is also inclusive of many types of informal learning opportunities and is not only limited to formal training courses. Sharma and Kitchens (2004) described that many pedagogies had evolved from e-Learning to m-learning. This research identified the changes in teaching and learning practices from e-learning to m-learning as illustrated in the Table 2. The major paradigm shift was contextually identified by location, pedagogy, communication, feedback, assignment and the assessments of a typical course.

Table 2: Differences between e-Learning and m-Learning, (Sharma & Kitchens, 2004)

Subject	E-Learning	M-Learning
Place	lecture in classroom or online labs	learning anywhere, anytime
Pedagogical Change	More text and graphics based instructions	More audio, graphics and animation based instructions
	classroom lectures or internet labs	learning in the field or while mobile
Instructor to Student Communication	Time-delayed (students need to check e-mails or web sites	Instant delivery of e-mail or SMS
	passive communication	Instant communication
	Asynchronous	Synchronous

	Scheduled	Spontaneous
Student to Student Communication	Face-to-Face	Flexible
	Audio- teleconference common	Audio / video-teleconference possible
	e-mail-to-e-mail	27/4 instantaneous messaging
	private location	no geographic boundaries
	travel time to reach to internet site	no travel time with wireless internet connectivity
	dedicated time for group meetings	Flexible timings on 24/7 basis
	poor communication due to group consciousness	Rich communication due to one-to-one communication, reduced inhibitions
Feed back to student	1-to-1 basis possible	1-to-1 basis possible
	Asynchronous & at times delayed	Both asynchronous and synchronous
	Mass/standardized instruction	Customized instruction
	Benchmark-based grading	Performance & improvement grading
	Simulations & lab-based experiments	Real-life cases and on the site experiments
	Paper based	Less paper, less printing, lower cost
Assignments & Tests	In-class or on computer	Any location
	Dedicated time	24/7 Instantaneous
	Restricted amount of time	Any amount of time possible
	Standard test	Individualized tests
	Usually delayed feedback	Instant feedback possible
	Fixed-length tests	Flexible-length/number of questions
Presentations, Exams & Assignments	Theoretical and text based	Practical oriented exams direct on site, hands- on based
	Observe and monitoring in lab	Observe in the field and monitoring from remote location
	Class-based presentations	1-to-1 presentations with much richer communication
	Usually use of one language	Automatic translation for delivery of instructions in many languages
	Mostly individualized, component based group work	Simultaneous collaborative group work
	Paper-based assignment delivery	Electronic-based assignment delivery
	Hand-delivery of assignments at a particular place and time	E-delivery of assignments at any place and time
	Instructor's time used to deliver lectures	Instructor's time used to offer individualized instructions and help

2.16 Mobile Learning Advantages

Mobile based education is often described in terms of both learning content and hardware. It is often learning that is delivered or supported solely or mainly by handheld and mobile technologies such as personal digital assistants (PDAs), Smartphones or Tablet PCs (Mac Callum & Jeffrey, 2010). Some of the advantages of mobile learning are mentioned below (Naismith, Lonsdale, Vavoula, & Sharples, 2004).

1. Seamless access to learning resources: m-learning allows learners to study anywhere, either in a classroom or on a laptop or pocket device. A true mobile learning system allows users to take a course on any device.
2. Freedom, power, and choice: M-learning students can choose where, when and how they will study; either online synchronized learning, online self-paced learning, downloaded courseware or computer-based training. M-learning offers new levels of freedom with the ability to exercise control over learning patterns.
3. Potentially a more rewarding learning experience
4. Improving levels of literacy, numeracy and participation in education amongst young adults.
5. Using the communication features of a mobile phone as part of a larger learning activity, e.g.: sending media or texts into a central portfolio, or exporting audio files from a learning platform to one's own phone.
6. Relatively inexpensive opportunities, as the cost of mobile devices are significantly less than PCs and laptops
7. Organized productivity: With only a cell phone, handheld device, PDA, or hybrid unit, users can access administrative functions, communicate, download courses, and review their learning history through a learning management system. M-learning offers an efficient way for learners to access key information and maximize their time.
8. Flexible, portable convenience: The ability to customize learning schedules is a key advantage of m-learning. Learners are not restricted to a specific physical environment, a particular delivery channel, or fixed sets of time for undertaking training and education. Using the latest technology, students can update their knowledge base on a just-in-time basis to prepare for meetings or presentations.

However, there are differences further between e-Learning and m-Learning as mobile devices have some restrictions compared with other e-learning tools (Smarkola, 2011). These restrictions are their limited processing power and resources, the smaller screen sizes and their relative low resolution that make it harder to present learning content in a user-friendly way (Istanbullu, 2008). Because of these restrictions, current e-learning courses, pedagogies, e-learning standards etc. may not be in the formats that mobile devices would accept.

Thus, an instructor needs to prepare courses in a compact form that can be displayed on mobile devices. In fact, a holistic approach to learning and teaching with appropriate consideration for both e-learning and m-learning would be preferable. m-Learning is quite a new domain, and there is a lot of work and research that is presently going on in this field. Specifically, people are trying to understand the following topics (Andronico, Carbonaro, Casadei, Colazzo, Molinari, & Ronchetti, 2003).

1. Which learning models can help in better learning
2. How to evaluate the acceptance and effectiveness of mobile devices
3. What features can efficiently diffuse mobile learning in a learning environment and Learning Management System (LMS)

2.17 Mobile Learning Theories

According to Alsaadat (2011) m-learning can be classified into three types: formal, informal, and self-directed learning. In formal learning, a learner is reminded with notifications and prompts that help him to keep his learning organised. In an informal learning environment, learning strategies are used such as engaging in interactive messaging which fosters two-way communication and using popular social media to create collaborative learning environments. Lastly, in the user directed learning environment, a learner is directed with learning content, support materials and media-based content such as podcasts or videos.

Keskin and Metcalf (2011) highlights that there are many popular mobile learning theories which engage learners in mobile learning environments such as Behaviourism, Cognitivism, Constructivism, Situated Learning, Problem-Based Learning, Context Awareness Learning, Socio-Cultural Theory, Collaborative Learning, Conversational Learning, Lifelong Learning, Informal Learning as well as Activity Theory, Connectivism, Navigationism and Location-based learning, as described in Table 3.

Table 3: Learning theories and Implications for Mobile Learning (Keskin & Metcalf, 2011)

Theories	Definitions	Focus	Examples with mobile technologies
Behaviourist Learning	Learning has occurred when learners evidence the appropriate reinforcement of an association between a particular response and stimulus	Information and content delivery in mobile learning Language learning: Tests, practices, quizzes, listening-practice speaking Drill and feedback: Mobile Response System Content delivery by text messages.	English learning applications SMS, MMS, Voice recorder software Mobile Response System: Windows, Turning Point Response System Tell me tech. (searching)
Cognitivist learning	Learning is the acquisition or reorganization of the cognitive structures through which humans process and store information	Information and content delivery in mobile learning Using Multimedia learning (Dual code, Cognitive Load Theory): Images, audio, video, text, animations	Multimedia (text, video, audio, animation, images) SMS, MMS, e-Mail Podcasting Mobile TV
Constructive learning	Learning is a process in which learners construct new ideas or concepts based on their current and past knowledge	Context and content-dependent mobile learning Questions for Exploration Cases and examples, Problem solved and Decision making applications	Handheld games, Simulations, Virtual reality, Interactive Podcasting and SMS Interactive mobile TV and SMS
Situated learning	Learning is not merely the acquisition of knowledge by individuals, but instead a process of social participation	Social Context and Social participant dependent mobile learning Authentic domain activity Collaborative social interaction Cooperative activities Expert modelling Situated mentoring Workplace learning	Natural science learning Medical education Multimedia museum Virtual experts by artificial intelligence tech. Mobile performance support system

Problem-based learning	Learning aims to develop students' critical thinking skills by giving them an ill- defined problem that is reflective of what they would encounter as a practicing professional	Problem based context and solved based content-dependent mobile learning Problems — Solutions Case centred activities Collaborative social interaction	Medical education Business administration Nursing Simulations SMS MMS Voice responds systems
Context awareness learning	Context awareness means gathering information from the environment to provide a measure of what is currently going on around user an the device	Context aware in mobile learning Context-dependent content management Contextual event notification Context-aware communication Navigation and retrieval of learning materials User interface adapted according to time and location contexts	Multimedia museum and gallery Pre-class podcasts Films e-book-s Podcasting
Socio-cultural theory	Learning occurs first through interpersonal (interaction with social environment) than intrapersonal (internalization)	Social Context and Social participant dependent mobile learning Mobile experts Community of practice Workplace learning Mobile communication	Mobile performance support system Virtual experts Mobile forum, E-mail Social network (Web 2.0 tools)
Collaborative learning	Learning is promoted, facilitated and enhanced by interaction and collaborations between students.	Collaboration and interaction dependent mobile learning Actively participation Social context Communication between peers via mobile phones.	Mobile Assisted Language Learning Mobile Response System Mobile computer supported collaborative learning Forum, Web 2.0 tools, email, mobile portal, games
Conversational Learning theory	Learning is in terms of conversations between different systems of knowledge	Interaction and communication dependent mobile learning Solving a problem Exploring an environment	Laboratory classes Field trip Mobile computer supported collaborative learning Calling, Interactive Voice

		Communication between peers via mobile phones.	Respond (IVR)
	interpersonal (interaction with social environment) than intrapersonal (internalization)	participant dependent mobile learning Mobile experts Community of practice Workplace learning Mobile communication	system Virtual experts Mobile forum, E-mail Social network (Web 2.0 tools)
Conversational learning	Learning is in terms of	Interaction and	Laboratory classes
learning	conversations between different systems of	communication dependent mobile learning	Field trip Mobile computer supported
	knowledge	Solving a problem Exploring an environment Communication between peers via mobile phones.	collaborative learning Calling, Interactive Voice Respond (IVR)
Lifelong learning	Learning happens all the time and is influenced both by our environment and the particular situations we are faced with	Lifelong information and interaction with education content in mobile learning Podcasting Information resources Mobile web site	Social networks (Blogs, Wikipedia, Twitter, YouTube) Podcast E-mail Mobile Forums
Informal learning	Learning is a process of learning that occurs autonomously and casually without being tied to highly directive curricula or Instruction	Information and interaction with educational content in informal mobile learning setting Mobile information resources Mobiles in a museum setting Field Trips Science Field Work	Social networks (Blogs, Wikipedia, Twitter, YouTube) Podcast E-mail Mobile Forums
Activity theory	Learning occurs with three features-involving a subject (the learners), an object (the task or activity) and tool or mediating artefacts and human behaviour is situated within a social context that influences their actions	User actions in social context dependent mobile learning Actively participation Social context Activities	Museum Art Gallery exhibit via SMS, polls, calling Mobile Games Multimedia

Connectivism	Learning is the process of connecting specialized nodes or information sources	Diversity of information sources in mobile learning Connecting specialized nodes Information sources Facilitate continual learning environment Knowledge management activities Decision-making	Social networks (Blogs, Wikipedia, Twitter, YouTube) Podcast E-mail Mobile Forums Discussion Platforms Podcasting
Navigationism	Learning is a process of connecting specialized nodes or information sources	Complex of information sources in mobile learning Connecting specialized nodes Information sources Facilitate continual learning environment Knowledge management activities Decision-making Manage information (identify, analyse, organize, classify, assess, evaluate, etc.) Sense making and chaos management.	Social networks (Blogs, Wikipedia, Twitter, YouTube) Podcast E-mail Mobile Forums Discussion Platforms Podcasting
Location based Learning	Location-based learning holds promise for just-in-time learning tied to a student's physical location	Location context in mobile learning Conceptual knowledge Conceptual application Constructive environment Partnership with location Immersive activities	Field trips Archaeology studies Location based game Virtual world Google Map, GPS, RFID, network-triangulation

2.18 Smartphones

According to Litchfield a Smartphone runs an open (to new apps) operating system and is permanently connected to the Internet (Litchfield, 2010). Smartphones are generally equipped with a range of advanced computing features and can synchronize data with a personal computer (PC). White and Turner (2011) state that Smartphone computing platforms are gradually being used for instruction because such devices are becoming common as the primary computing devices used by people, and because they can excite students about computing and networking. Estimates suggest that about 57% of the university students in USA use Smartphones and there are 1.5 million iPads (tablet PC) used in education (Gikas & Grant, 2013).

Estimates also suggest that more than half of the population in the UK, Norway and Sweden own Smartphones (Alfawareh & Jusoh, 2014). In 2010, 88.3 million PCs were sold worldwide. The same year saw 80 million Smartphones been purchased, including 20 million Android devices and 14.1 million iOS phones (White & Turner, 2011). Smartphones and tablets are primary leaders of accessing m-learning content when compared to other mobile devices like, Pocket PC, Personal Diary Assistant (PDA), Laptops, netbooks etc. (Godwin-Jones, 2011).

Although there are some drawbacks of using Smartphones (e.g., the small screen size), the major advantages are:

1) the majority of learners have Smartphones (Hsu, Rice, & Dawley, 2012)
2) most Smartphones are cheaper than desktop or laptop computers
3) the size and weight of Smartphones aid anytime-anywhere learning

Their higher penetration can ensure that most learners engage in mobile learning based on a 'technological push' pedagogy (Smarkola, 2011). As Smartphones are already popular among young people, homes and social places, we face new problems and issues that pertain to the optimal use of technologies to support learning (Nassuora, 2012).

Many researchers have reported the threat of students misusing mobile technologies while using them for learning (Shudong & Higgins, 2005). They claim that students can often get tempted to lose attention as most adolescents lack strict self-discipline in the absence of a proper guided learning atmosphere.

2.19 Engineering Programme

According to Rossi, Pastor, Schwabe, and Olsina (2007, p. 423)

> *"Engineering programme is defined as the profession of applying scientific principles to the design, construction, and maintenance of engines, cars, machines, etc. (mechanical engineering), buildings, bridges, roads, etc. (civil engineering), electrical machines and*

communication systems (electrical engineering), chemical plant and machinery (chemical engineering), or aircraft (aeronautical engineering)."

The study of engineering, by its very nature, challenges students with an aptitude for tactile learning. Engineering problem solving requires a mastery of analytical thought processes, problem solving, problem schematics, the ability to derive, manipulate, and solve mathematical equations, illustrate visual diagrams and physical intuition (Edward, 2007). Considering the learning styles associated with students of the digital age, this profile of characteristics is adding an extra dimension to the students' learning paradigm. Millennial students generally favour collaborative problem solving, often employ trial-and-error approaches, and seem to have less affinity for the traditional lecture format. They also tend to multitask and show high competence in all manners of digital media, which is an important evolution from historically recognized learning patterns (Ricardo, 2008).

Technology is vital to engineering studies and is part of its day-to-day learning experience. During the last part of the 20th century, technologies related to communications and the Internet led to a revolution giving birth to highly interactive, simulation driven e-learning courses, 3D visualization and advance data visualization, among others, thus facilitating teaching and learning in engineering studies. With the advent of Web 2.0, students have evolved from being passive readers to active players publishing their own content and interacting with research and academic communities in virtual social networks. In another study, the low performance of a California community engineering college was dealt with by using Tablet PCs. These were used to improve the effectiveness of the engineering programme by increasing their productivity and by improving the viability of community college engineering programs (Enriquez, 2009).

Engineering programmes can greatly benefit from Smartphones that offer easy access to electronic learning resources, messaging, push-pull communication, audio, video and text chatting, as well as virtual reality environments (either on-line or off-line). The benefits of Smartphones also include location based learning such as field-trips, enhancing interactivity in contact teaching situations, engaging 'shy' learners through use of familiar, non-threatening technologies. Additionally, engineering students can interact, input data, write, illustrate and draw engineering and technology problems. Applications driven by inbuilt sensors and capabilities in Smartphones offer excellent opportunities as a single tool for engineering and technology measurement, calculation, simulation, visualization, augmentation, to name a few.

Whilst m-learning offers clear opportunities for engineering programmes, a few pedagogical concerns do exist. Despite growing interest from both academic and student communities, the issues regarding the promotion of a learner's adoption of mobile learning seem to be largely unsolved. For instance, according to Corbeil and Valdes-Corbeil (2007) the availability of various mobile devices for students does not guarantee their use for educational purposes. Hence a successful integration of these devices depends on a deep understanding of their integration and adoption. There is an urgent need to recognize the factors influencing the user's behavioural intention for the acceptability and usability of mobile devices (Corbeil & Valdes-Corbeil, 2007). This proposed study will work towards understanding the acceptance of Smartphones in University programmes.

2.20 College of Education (Teacher Education Programs)

Institutions that provide teacher-education programmes typically involve the development of teacher proficiency and competence. This body of education concentrates on teaching skills and sound pedagogical theories that can enable the potential teacher to teach different levels - from pre-primary to higher education. These teaching skills may include providing training and practice in the different techniques, approaches and strategies that would help the teachers to plan and impart instructions, provide appropriate reinforcements and conduct effective assessments. The Dictionary of Education describes teacher education in the following words (Thakur, 2015, p. 2):

> *Teacher education means, ―all the formal and non-formal activities and experiences that help to qualify a person to assume responsibilities of a member of the educational profession or to discharge his responsibilities more effectively.*

Similar to other professional education programs, the curriculum of teacher education is based on knowledge concerning the needs of its practical applications along with the conceptual blending of theoretical understanding available in several cognate disciplines. According to Ravi (2016, p. 44).

> *"People come to teacher education with beliefs, values, commitments, personalities and moral codes from their upbringing and schooling which affect who they are as teachers and what they are able to learn in teacher education and in teaching"*

Substantial research suggest that a significant impact of teachers on the quality of teaching and learning (Kane & Francis, 2013). The quality of teacher education has become ever more important, but there continue to be doubts about whether the systems and programs which educate and prepare these professionals are robust enough to meet the challenges of future learning needs. Scaccia and Giovannella (2012), illustrates that schools of education and teacher training waste far too much time on theory and social psychology at the expense of direct, subject specific strategies. Furthermore this article recommends that teacher education programmes significantly change the way they prepare teachers to run classrooms. The College of Education, like other academic institutes, can work on integrating Smartphone technologies that are susceptible to change the way education will be delivered for future learners.

There are few studies which have analysed the potential of a mobile learning system in a teacher training programme. Lan and Sie (2010), highlights the possibilities of using m-learning technology with handheld devices in a College of Education, which potentially removes geographical proximities and fosters collaborative learning with individuals and groups. Liu et al. (2010) illustrates that learning environments should be extended far beyond the classrooms and schedules using mobile devices. According to Roach (2002) mobile devices provide the facility of ubiquitous learning; they have been used by learners from all stages of primary to university.

Some studies that considered the potential of a mobile learning system in a training environment were focused on teacher training to solve the problems of communication. Other mobile learning projects were developed to support the mentoring of teachers (Douch, Attewell, & Dawson, 2010). Vaughan and Lawrence (2013) investigated the role of mobile devices in a blended pre-service teacher education program and found that the students were more adept in using mobile devices than their faculty members.

Responsible stakeholders in a College of Education should remain aware of the potentials of new educational technologies. The opportunities of collaboration and learning offered by mobile technologies are numerous, fundamentally unique and rewarding in mobile contextualized learning environments.

2.21 Systematic Review of literature

Systematic Review and Meta-analysis are techniques which attempt to associate the findings from similar studies and deliver quantitative summaries of the research literature (Morris, 2007). The Systematic review of research literature identifies the common research methods, research design, sample size, parameters used, survey instruments, etc. used by the group of researchers. Furthermore, this method also helps researchers to identify the required descriptive and inferential statistics shared by the selection of studies under review (Wolf, 1986). Meta-Analysis techniques also help researchers make better decisions over the research methodology, research validity and over the formulating of hypotheses.

Wolf (1986) posit that good Systematic Reviews and Meta-analyses cover a large sample of relevant studies, which aids in the robustness of the conclusion and findings. Schmidt and Hunter (2014, p. 26) describes a four step temporal sequence in conducting meta-analysis which begins by collecting research studies, followed by extracting information, followed next by meta-analysis methods to extract information; and then finally ends in presenting the results.

This research conducted the systematic review and meta-analysis of literature by first selecting the relevant published literature for the last 10 years from the field of technology acceptance quantitative studies. This was due to the fact that Smartphone technology was invented around 2007. The other reason was that the derivation of the UTAUT model was in the year 2003 while the UTAUT2 model was conceived in 2012. The second criteria was considered for selecting the relevant literature adhering to Information and Communications Technology (ICT), mobile technologies, e-Learning and mobile learning technology acceptance in educational settings. Finally, the third criteria was to select the published research from varied geographical regions, as mentioned in the Table 4 below.

The selection of the articles was conducted using Adobe Acrobat Processional software text find and Highlight script. This macro script identifies specified words and phrases across multiple documents tags, highlights and counts their respective occurrences in each article. This technique automated the selection of research articles defined by the criteria identified in Appendix A and resulted in recognising 59 research articles. The next selection criteria had filtered the research articles to 49 after removing those studies which were not quantitative or were repetitive, those that did not discuss results and analysis; it also removed studies with large sample sizes (> 500).

The selection of literature for the meta-analysis of study was carried out after a comprehensive manual search from databases such as Science Direct, JSTOR, SAGE Online, Elsevier, ProQuest, Wiley Inter-Science, ACM Digital Library, Elsevier, and MIS Quarterly. The keywords identified in the criteria include “UTAUT”, “UTAUT2”, “Technology Acceptance”, “mobile learning”, “Smartphone”, “Technology acceptance in Engineering Education”, “Technology acceptance in Teacher Education”, “Technology Adoption” and “Behaviour Intention to Use Technology”.

Table 4: Research article selection criteria

Must Include	Preferred
1. involve quantitative analysis 2. UTUAT or UTAUT2 model	1. involve mobile technology in higher education 2. investigate ICT devices 3. Smartphone technology acceptance 4. Smartphone as a learning tool 5. published journal article 6. published between 2006 to 2015

A few publications were eliminated even though they met the above mentioned criteria; this was because they did not conclude the results or findings of the research. Like any other statistical techniques, meta-analysis can also mislead if the selection and elimination criteria are not well defined or properly conducted. This study incorporated all the necessary steps to make sure that there is no unintended bias, errors or any skipped process in selecting the literature pool as well as to avoid a potential bias (Schmidt & Hunter, 2014, p. 26; Stanley, 2001).

2.22 Meta-Analysis Results

The collected literature review data was classified into six main categories as highlighted in the Table 5. The first category was "Descriptive information" which included the Code, Author, Year of publication, Technology investigated and the Geographical region of the study. The second group was "Statistical Power" which categorised sample size, number of constructs and number of survey items used. The third group "Software" identified software tools used and the Pilot study carried in the research. The fourth set "Model" identified the use of UTAUT and UTAUT2 models by the research. The fifth group "Moderator" collected the moderators investigated by each study respectively. Finally, the sixth group identified types of descriptive statistics, inferential statistics, (exploratory factor analysis, model-fit, confirmatory factor analysis and scale evaluation) and other common statistical tests used by respective studies, as shown in Appendix A.

Table 5: Meta-analysis classification criteria

No	Items	Description
1	**Descriptive Information**	Author Year Technology Region Mobile Tech.
2	**Statistical Power**	Sample Constructs Items
3	**Software**	Software Pilot
4	**Model**	UTAUT

		UTAUT2
5	**Moderators**	Gender Moderator Age Moderator Other Moderator
6	**Analysis Techniques**	Descriptive (Mean, STD, Cronbach's alpha,) EFA (Exploratory Factor Analysis) Scale Evaluation (Model-Fit) CFA (Confirmatory Factor Analysis) t-Test ANOVA (Analysis of variance) Regression

The list was sorted in the descending order by the year of publication. Each corresponding information was recorded with an "X" in the conforming entry, and only the information for the sample size, number of constructs and survey items was recorded against their actual values. Basic descriptive data analysis was carried out against each group to assess the average values to establish the assertion.

Statistical Power: The second set of meta-analyses assessed sample size, the UTAUT constructs studied and the average number of questions used in each study. The results identified that an average of 274 responses were collected per study, as well as an average of seven constructs per study. The meta-analysis identified that the average number of questionnaire items used per study was 25 as mentioned in Table 6.

Table 6: Sample size, UTAUT constructs and the no of questionnaires items frequency

2-Statistical Power	**Mean Score**
Sample size	274
UTAUT Constructs Studied	7
Questionnaire Items	25

The software applications used while analysing technology acceptance using UTAUT and UTAUT2 models were mostly IBM SPSS, IBM AMOS, PLS Graphs and LISREL. 29% of researchers used IBM SPSS for exploratory factor analysis, 16% of them used IBM

AMOS for confirmatory factor analysis, while 27% of the researchers used PLS Graph for confirmatory analysis. 6% of the researchers were found to have used a combination of IBM SPSS and AMOS for the same purpose. 2% were also found to be using the LISREL application for conducting factor analysis and for confirming the hypothesis of the research. With the above data it was evident that IBM SPSS and AMOS were found to be the most common software's among the selected set of literature, as shown in Table7.

Table 7: Type of software applications used by the researchers

3-Software Application	**Total**	**%**
SPSS (IBM)	14	29%
AMOS (IBM)	8	16%
PLS	13	27%
SPSS/AMOS (IBM)	3	6%
LISREL	1	2%

Study Model: The systematic analysis of the literature review focused mainly on the studies that incorporated the UTAUT and UTAUT2 models which investigated technology acceptance. From the collection of research studies a total of 65% investigated information technologies acceptance by using the UTAUT; while 29% research studies focused on the UTAUT2 model, as shown in the Table 8. An analysis of moderators used in technology acceptance revealed that a total of 67% of the studies investigated gender as a moderator and at the same time 63% of them investigated age as the moderating effect. A total of 47% of the studies had also incorporated other genders such as the experience of using technology, the educational level, etc. The analysis of the literature review also highlighted that a total of 18% of the studies had run Pilot studies before conducting the main study, as shown in Table 8.

Year of publication: An analysis of the research publication year reveals that 2013 witnessed 27% of the studies from the pool of research publications selected for this literature review, with most of the studies focused on mobile technology acceptance, as illustrated in Table 9. The year 2012 witnessed the next highest published with a total of 16% of them investigating technology acceptance. Among those eight studies, three covered mobile technology acceptance. The years 2012 and 2010 had 16% and 12% published research with three of those studies covering mobile technology acceptance respectively. While in 2009, 2014, 2008, 2007 and 2006, all pooled 3 to 2 studies respectively.

Table 8: UTAUT models and moderators used by the researchers

4-Models		**Total**	**%**
1	UTAUT Model	32	65%
2	UTAUT2 Model	14	29%
5-Moderators			
	Gender Moderator	33	67%
	Age Moderator	31	63%
	Other Moderator	23	47%
	Pilot Study	9	18%

A total of 27% studies out of 49 research journals covered mobile learning and about 8% research studies covered Smartphone technology acceptance. Among these four, only one study investigated Smartphones for ubiquitous learning (u-learning). The concept of U-Learning is an extension of basic mobile learning where learning content is accessed in various contexts and situations (Admiraal et al., 2013).

Table 9: Year of publication with the respective technologies

Year	Technology	Count	Total	%
2015	Pervasive Information Systems	1	2	4%
	Phablets	1		
2014	Mobile Hospitality	1	4	8%
	Smartphone	*1*		
	Social Media	1		
	Social Networking	1		
2013	LMS	2	13	27%
	Mobile banking	1		
	Mobile Learning	**5**		
	Mobile Payment	1		
	NFC	1		
	Online Banking	1		
	Online Music Service	1		

	Technology	1		
2012	Computer	1	8	16%
	Mobile banking	2		
	Mobile Learning	**1**		
	Smart Card	1		
	Technology	1		
	Telecom	1		
	WBT	1		
2011	eBay	1	3	6%
	Smartphone	*2*		
2010	Driver Support System	1	6	12%
	ICT	2		
	Mobile Computing	1		
	Mobile Search	1		
	Model Validation	1		
2009	***Mobile Learning***	**4**	5	10%
	Smartphone	*1*		
2008	3G Mobile	2	3	6%
	Mobile Learning	**1**		
2007	ICT	1	2	4%
	Infomediaries	1		
2006	Games	1	3	6%
	Mobile Technology	2		
	TOTAL	**49**		**100%**
	Total Mobile Learning	**13**		**27%**
	Total Smartphone	**4**		**8%**

Region: It was found that the investigation of technology acceptance was being conducted among all regions of the globe. The region of Asia had seen 47% studies conducted with China registering most of the studies followed by Malaysia with 6 studies each. The second region investigating technology acceptance most (by using the two models) was Europe with 24% of the research studies. North America saw 8% of the studies followed by the Middle East with 6%, Oceania with 4% of the studies and finally South America with 1 study 2%, as illustrated in Table 10.

Table 10: Frequency of UTAUT models used against the regions and countries

Country	UTAUT	UTAUT2	Total
ASIA			**47%**
China	4	2	6
Malaysia	4	2	6
Taiwan	4	1	5
Bangkok	2		2
Thailand	2		2
Indonesia		1	1
South Korea	1		1
Total	**17**	**6**	**23**
OCEANIA			**4%**
Australia	1	1	2
AFRICA			
Nigeria	1		1
MIDDLE EAST			**6%**
Jordan	1	1	2
Saudi Arabia	1		1
Total	**2**	**1**	**3**
EUROPE			**24%**
UK	2	1	3
Germany		2	2
Finland	2		2
Sweden	1		1
Netherland		1	1
Portugal		1	1
Spain		1	1
EU	1		1
Total	**6**	**6**	**12**
NORTH AMERICA			**8%**
USA	4		**4**
SOUTH AMERICA			**2%**
Brazil	1		**1**
TOTAL	**32**	**14**	
	65%	**29%**	

Meta-Analysis of Mobile Learning Technology Acceptance Studies: The next stage of meta-analysis focused on extracting studies which exclusively concentrated on assessing the acceptance of mobile technologies or mobile learning out of the final 49 research studies. A total of 23 research studies were identified after this criteria, as shown in Table 11. A total of nine studies focused exclusively on mobile learning.

Table 11: Research studies using mobile technologies and Smartphone

No	Author	Year	Technology	Count	Region
1	Abu-Al-Aish et. Al.,	2013	Mobile Learning	9	UK
2	Yang S.,	2013	Mobile Learning		China
3	Yang,	2013	Mobile Learning		China
4	Jambulingam,	2013	Mobile Learning		Malaysia
5	Almatari et. All.	2013	Mobile Learning		Malaysia
6	Nassuora,	2012	Mobile Learning		Saudi Arabia
7	Wang et. All.,	2009	Mobile Learning		China
8	Jairak et al.,	2009	Mobile Learning		Bangkok
9	Liu,	2008	Mobile Learning		Finland
10	Y.-L. Wu et al.,	2008	Mobile (3G)	10	Taiwan
11	Raman et. All.,	2013	Mobile (LMS)		Malaysia
12	Yu,	2012	Mobile (Banking)		Taiwan
13	Moran et al.,	2010	Mobile (Computing)		USA
14	Zhang et al.,	2010	Mobile (Search)		China
15	Carlsson et al.,	2006	Mobile (Technology)		EU
16	Sundaravej,	2010	Mobile (Validation)		USA
17	Williams et al.,	2012	Mobile (Technology)		Australia
18	Abdulwahab et al.,	2012	Mobile (Telecom)		Nigeria
19	Alrawesh et. All.,	2012	Mobile (WBT)		Jordan
20	**S Pheerap et. All.,**	**2014**	**Smartphone**	**4**	**UK**
21	**Dong-Hee et. All.,**	**2011**	**Smartphone**		**South Korea**
22	**Pitchsys..,**	**2011**	**Smartphone**		**Thailand**
23	**Chen et al.,**	**2009**	**Smartphone**		**Taiwan**

It can also be observed that most of the publications were reported after 2008 and about 12 studies accounting to 50% of the research were published in the years 2012 to 2014. It is also evident that many of the research studies mentioned in Table 12 were conducted in the South East Asian region.

Table 12: Research studies using statistical power, software's application

	Statistical Power	No. of Studies	Average
1	**Sample**		246
2	**Constructs**		7
3	**Items**		24
	Software		
1	SPSS	6	26%
2	AMOS	5	22%
3	PLS	6	26%
	Model		
1	Pilot	2	9%
2	UTAUT	19	83%
3	UTAUT2	3	13%
	Moderator		
1	Gender	17	74%
2	Age	15	65%
3	Other	13	57%
	Data Analysis Technique		
1	Descriptive	18	78%
2	EFA	14	61%
3	Scale Evaluation	17	74%
4	CFA	15	65%
5	t-Test	1	4%
6	ANOVA	0	0%
7	Regression	6	26%

Table 12 illustrates that the average sample size was 246, with an average of 7 constructs and about 24 items reported as part of the questionnaire for the 23 studies. A total of 50% of the studies among the 23 listed used IBM SPSS and AMOS, while a total of 90% used the UTAUT model to study technology acceptance. More than 65% of the studies assessed the effect of gender as a moderator while more than 60% of the 23 enlisted studies had conducted descriptive and inferential statistics using exploratory and confirmatory factor analysis techniques.

Pheeraphuttharangkoon et al. (2014) used the Unified Theory of Acceptance and Use of Technology (UTAUT) to assess the adult adoption of Smartphones by using the 50+ age demographic group. Data was collected with an online survey and a total of 204 completed replies. The path analysis found that observability, compatibility, social influence, facilitating conditions, effort expectancy and enjoyment were significant predictors of the use of Smartphones by adults over 50.

Shin et al. (2011) aimed at understanding the primary factors influencing the user's intention to continually use Smartphones as a ubiquitous learning tool. The aim was to enhance this tool's usability and functionality by assessing the learner's experience after collecting the data from ten South Korean Universities. The study incorporated the UTAUT model and confirmed its significance in predicting user attitudes and behavioural intentions towards using the Smartphone as a learning tool.

A similar study conducted by Pitchayadejanant (2011) in using Smartphones, studied the significance of Perceived Value between the two groups of Smartphone users, by comparing iPhone and Blackberry users. The Structural Equation Model (SEM) technique was used and the results indicated that Perceived Value and Facilitating Conditions were the two strongest predictors of Behaviour Intention to use Smartphones. Furthermore, Performance Expectancy, Effort Expectancy and Social Influence did not directly impact on Behaviour Intention but they made a significant impact on the Perceived Value construct. This study concluded that Perceived Value is the mediating variable for Performance Expectancy, Effort Expectancy and Social Influence for the Behaviour Intention to use Smartphones.

The fourth study assessed the empirical acceptance of Smartphones after comparing the four models (Chen, Yen, & Chen, 2009); Model-1: Technology Acceptance Model (TAM), Model-2: TAM with Self-Efficacy, Model-3: Innovation and Diffusion Technology (IDT) and Model-4: TAM with IDT and Self-Efficacy. The study varied all the factors and combined them to collect the survey data. Results show that the relationships amongst constructs were similar with Self-efficacy being the strongest predictor of behavioural intention followed by effort expectancy and facilitating condition.

The results also show that organizational and environmental factors were driving the attitude towards Smartphone adoption.

2.23 Chapter Summary

There seems to be an increasing trend in studying user acceptance of technology in various settings, technologies, regions, parameters and population samples. As both the UTAUT and the UTAUT2 model are relatively new, the amount of publications available are considerable with reliable results. The literature review of this research had found UTAUT and UTAUT2 models as the predominant model for conducting research in the fields of acceptance and user perceptions. The findings of this study are a valuable addition to the research continuation of technology acceptance in academia and particularly in tertiary education. The literature review conducted in this chapter investigated the underlying theories used as a foundation of the research methodology, the evolution of technology acceptance theories, and its dimensions, quantitative techniques, instrument design covering a large pool of research papers as part of the meta-analysis as explained earlier in this chapter.

This research selects the UTAUT2 model as the theoretical framework and aims to improve the predictability by addind new constructs and moderators to assess the acceptance of Smartphones in contextual environments.

Chapter 3

3.0 Research Model and Hypothesis

3.1 Introduction:

This chapter aims to present the assessment of an appropriate technology acceptance model and the theoretical background that was used to develop the hypothesis behind this research. At the outset, this research adopted the second version of the Unified Theory of Acceptance and use of Technology (UTAUT2) model. This was followed by a detailed review of the constructs and moderators used for this research. Finally, the last section of this chapter will present the discussions supporting the research hypotheses proposed by this study.

Terminology and acronyms used in this chapter.

1. CX: Context (sample population of a particular college of this study)
2. CX1: Context one (College of Engineering)
3. CX2: Context two (College of Education)
4. CX1+CX2: Context combined (combined population of the two contexts)
5. W: Women (gender)
6. M: Men (gender)
7. UG: Under Graduate educational level
8. PG: Post Graduate educational level

3.2 Research Model Selection

Technology acceptance models have slowly evolved towards incorporating human behaviour from the domain of information management science, sociology and psychology. The most prominent technology acceptance behaviour models are illustrated in Table 13. The study of technology acceptance has raised standards in the development of those same models. Subsequently, these models predict by addressing a wide range of parameters for technology acceptance.

Table 13: List of Technology Acceptance Models

Theory/Model	Acronym	Developed By	Year
Theory of Reasoned Action	TRA	Fishbein and Ajzen	1975
Innovation Diffusion Theory	IDT	Rogers	1983
Social Cognitive Theory	SCT	Bandura	1986
Theory of Planned Behaviour	TPB	Davis, Bagozzi and Warshaw	1989
Model of PC Utilization	MPUC	Thompson, Higgins and Howel	1991
Motivational Model	MM	Davis, Bagozzi, and Warshaw	1992
Technology Acceptance Model	TAM	Taylor and Todd	1995
Combined TAM and TPB	C-TAM-TPB	Taylor and Todd	1995
Unified Theory of Acceptance and Use of Technology-I	UTAUT1	Venkatesh, Morris, Davis, and Davis	2003
Unified Theory of Acceptance and Use of Technology-II	UTAUT2	Viswanath, Venkatesh, James Y. L. Thong and Xin Xu	2012

3.3 Theory of Reasoned Action TRA

Fishbein (1979) introduced the Theory of Reasoned Action (TRA) for the first time which asserted that the most important determinant of an individual's behaviour is his behavioural intention. Later, Ajzen and Fishbein (1970) revised and expanded this theory that identifies a person's intention to behave a certain way. Behavioural intent is seen as the main determinant of behaviour, and the TRA focusses on an individual's behaviour as well as the subjective norms of influential people or groups that could impact those attitudes.

The TRA has limitations in predicting behaviour (Peterson & Bredow, 2009) as shown in Figure 10. Ajzen (1991) suggest that the determinants for intention are not always limited to attitudes, subjective norms, and perceived behavioural control, but that there are other factors that influence human behaviour. Studies which conducted empirical validation claim that TRA explains only 40% of the variance of behaviour (Ajzen, 1991; Peterson & Bredow, 2009). Furthermore, researchers have found that the TRA neglected the importance of those social factors that could be determinants for individual behaviour (Grandon & Mykytyn Jr, 2004).

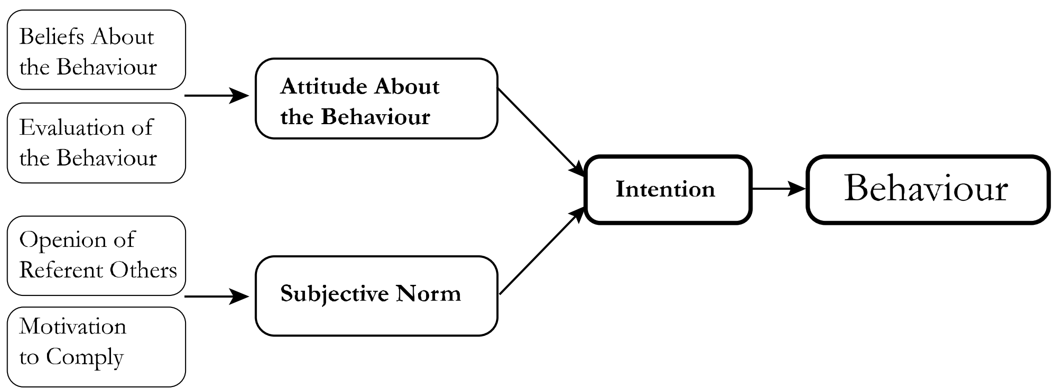

Figure 10: Theory of Reasoned Action (TRA), (Ajzen & Fishbein, 1980)

3.4 Theory of Planned Behaviour (TPB)

TPB was evolved from the inability or inaccuracy of the TRA in explaining behaviour that depended on the degree to which it was self-controlled as shown in Figure 11. Therefore, Ajzen and Fishbein (1970) proposed TPB as an extension to TRA's framework. The underlying principal of the Theory of Planned Behaviour is meant to predict behaviour in which people do not have complete self-control.

This extension - Perceived Behavioural control, is designed to interpret the factors outside an individual's control that may affect his intention or behaviour. TRA looks at an individual's attitudes towards a particular behaviour as well as the subjective norms of people who can influence those attitudes. Peterson and Bredow (2009) identify a significant gap between the assessment of behavioural intention and the behaviour being assessed. This research suggests that in a time gap, the intention of an individual could change. It also suggested that TPB is a predictive model that predicts the action of an individual by using a certain criteria; and that the individual does not always conform to the behaviour as predicted by said criteria.

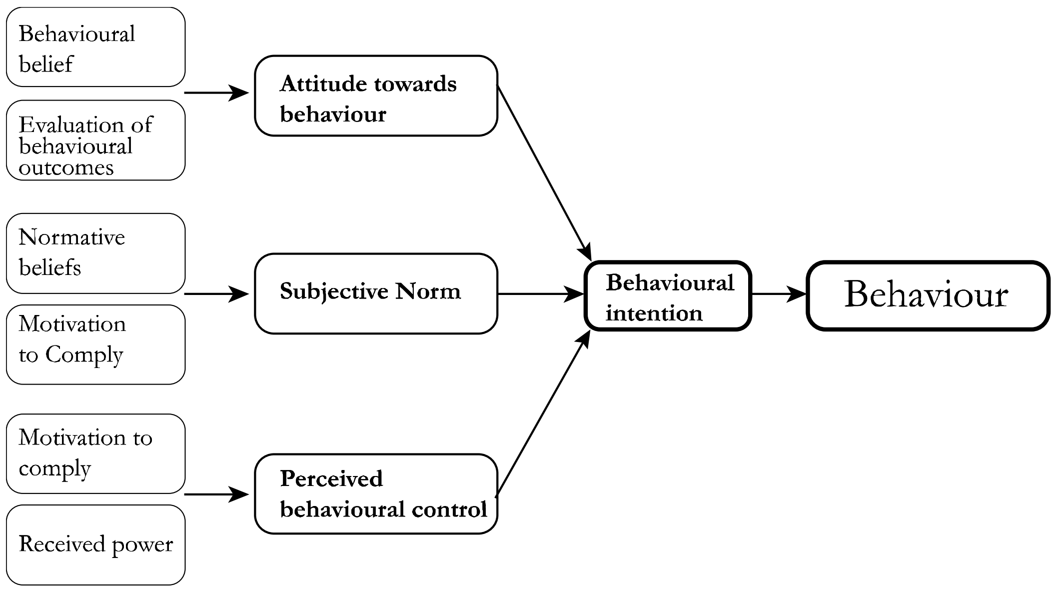

Figure 11: Theory of Planned Behaviour, (TPB, (Ajzen, 1991)

3.5 Technology Acceptance Model (TAM):

The domain of technology acceptance has always tried to accurately explain the user acceptance of information technology (DeLone & McLean, 1992). The Technology Acceptance Model (TAM) theory was proposed by Davis, Bagozzi, and Warshaw (1989). This theory was widely accepted as the foundation stone for explaining human behaviour in accepting technology. TAM posits that user acceptance can be explained by two beliefs: perceived usefulness and perceived ease of use, based on the Theory of Reasoned Action (TRA), (Davis Jr, 1986) as shown in Figure 12.

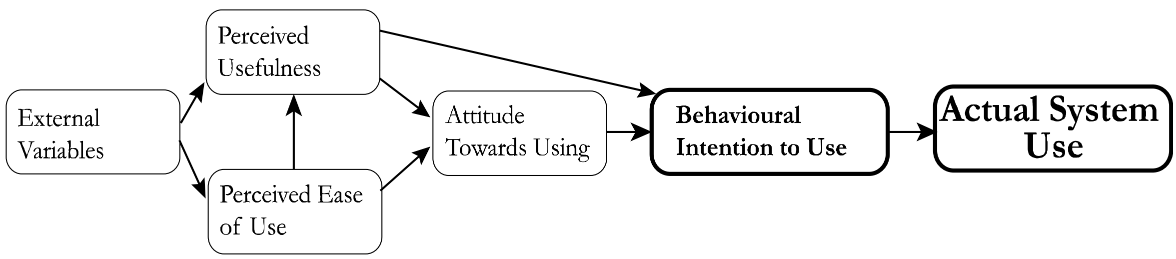

Figure 12: Technology Acceptance Model, (Davis et al., 1989)

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Gradmann, Borri, Meghini,

& Schuldt, 2011, p. 80). Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis et al., 1989). Later, a third construct was added to the model which was called Perceived enjoyment (Davis, 1993). Many researchers have tried to simplify TAM by eliminating the TRA attitude construct (e.g. (Venkatesh et al., 2003). TPB and TAM advocate strong behavioural elements; they assume that when a user intends to act, he will be free to act without limitation. But the real scenario contains some limitations such as limited ability, time, environmental or organisational limits and unconscious habits which are expected to limit the user's preference to adopt technology (Kwong & Park, 2008).

Taylor and Todd (1995) held that TAM failed to include factors of society and control that have been proven to affect actual behaviours. Perceived usefulness and perceived ease of use are also key factors in TPB. Thus, Taylor and Todd (1995) combined TAM and TPB in order to include both subjective norms and perceived behavioural controls into their technology acceptance model. Next, they conducted an empirical study on the students' use of computing resources and consequently proposed the C-TAM-TPB. The empirical results by Taylor and Todd (1995) show that C-TAM-TPB has a high model fit towards explaining a user's behaviour whilst using new technology. C-TAM-TPB showed good fitness for both experienced and inexperienced users after analysing the classifying of users based on their experience,.

Jen et al. (2009) in their attempt to compare the three models (TRA, TAM and UTAUT) concluded that (Davis Jr, 1986) had only considered the attitude of a person towards a given behaviour in his TAM model. TAM has also been found to be forecasting with only about 40% accuracy when predicting users' behaviour in adopting a system (Legris, Ingham, & Collerette, 2003).

3.6 The Evolution of Unified Theory

There are many research studies that have tried to verify the relevance, accuracy and robustness of all the dominant technology acceptance models in the pursuit to find a unified theory of acceptance (Agarwal & Karahanna, 2000; Chau & Hu, 2002; Koufaris, 2002; Lederer, Maupin, Sena, & Zhuang, 2000; Moon & Kim, 2001).

Jen et al. (2009) posits that adding new variables and constructs to the existing successful models will enhance the models' ability towards interpretation. This research identified models which evolved while representing technology acceptance include IDT, SCT, MPCU and MM. The selection of these sets of models used innovation theory, sociology, computer utilization and psychology to explore the acceptance behaviours of users towards technology, as illustrated in Figure 13. Venkatesh and Davis (2000) postulated that researchers developing technology acceptance models should consider a parsimony of models when postulating new models or theories. The term Parsimonious here means to simplify the model/theory with the least assumptions to variables with the highest explanatory power.

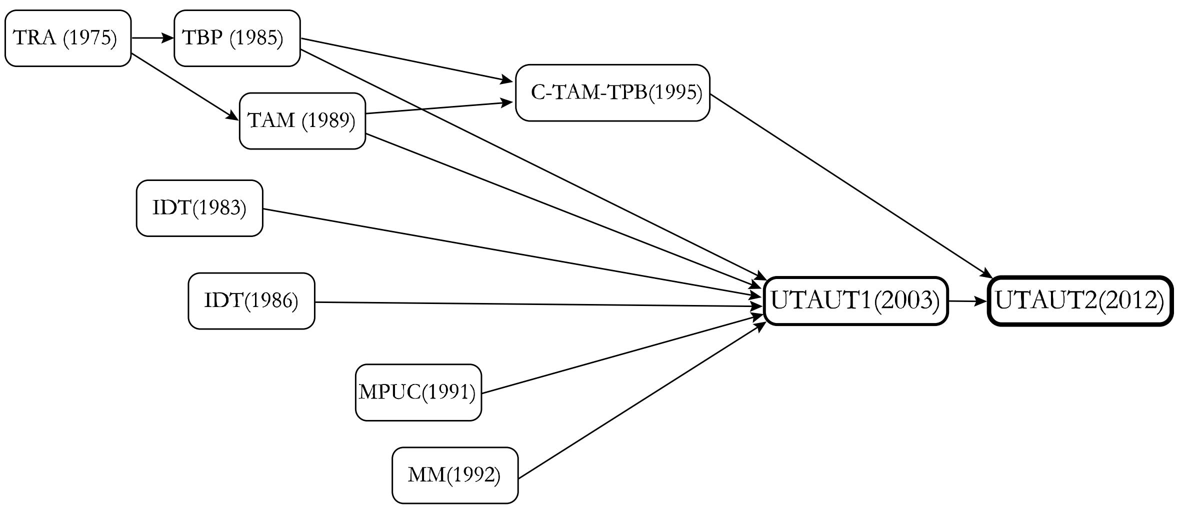

Figure 13: Evolution of Unified Theory of Acceptance and Use of Technology Model

Among these models and theories, the Technology Acceptance Model (TAM) has become popular in assessing technology acceptance until the evolution of the UTAUT model. TAM hypothesises that technology acceptance and use can be explained in terms of a user's internal beliefs, attitudes and intentions. However, the limitation of TAM is that it can act as the predictor of actual usage rather than that of the behavioural intention to use the technology (Turner, Kitchenham, Brereton, Charters, & Budgen, 2010).

Jen et al. (2009) conducted research in order to understand causal relationships among the variables by selecting three major theory models (TAM, C-TPB-TAM, and UTAUT). Jen et al. (2009) posited that previous researches employing TAM theory did not show consistent results in establishing causal relations with variables. An understanding of causal relationships is expected to help establish the strengths and weaknesses of correlations, such as the attitude towards use, the behaviour intention to use and the actual use behaviours.

The in-depth exploration by Jen et al. (2009) discovered that perceived usefulness directly affected the attitude towards use; and that the UTAUT model showed that perceived usefulness directly affected behaviour intention and the other two models (TAM and C-TPB-TAM). Confirmatory factor analysis was also made on the 3 models which measured different dimensions and model fitness index. The results showed significant levels of model fit indices in the UTAUT model. Jen et al. (2009) concluded that the UTAUT offers a more comprehensive exploration with its major predictor variables: performance expectancy (perceived), effort expectancy (perceived ease of use), social influence (subjective norm), facilitating conditions (perceived behavioural control), behavioural intention (attitude toward use).

In another similar study conducted by Legris et al. (2003), eight models were reviewed. These were the TRA, TAM, TPB, MM, UTAUT, PU, IDT and SCT which were assessed by conducting empirical studies on four organizations over a six-month period. The longitudinal study, assessing the eight prevalent technology acceptance models, explained between 17% and 53% of the variance in user intentions to use information technology among those models. The UTAUT was then tested and found to outperform the eight individual models (69% adjusted-R^2). Various studies conducted using UTAUT confirmed similar results (70% adjusted-R^2). Hence the UTAUT model can be considered a useful tool to assess the integration and acceptance of technologies. The UTAUT model was evolved after Venkatesh et al. (2003) consolidated the theory behind the Technology Acceptance Model (TAM).

3.7 Unified Theory of Acceptance and use of Technology UTAUT1

Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT1) after reviewing previous studies which provided a theoretical basis for hypotheses formulation of UTAUT1 as showed in Figure 14. This model combines all eight Information Systems (IS) key constructs, strengths and limitations. UTAUT1 has constructs and mediators, which encompass Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM) and TAM2, Motivational Model (MM), Theory of Planned behaviour (TPB), Model Of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT) (Raman & Don, 2013; Slade et al., 2013; Wang et al., 2009).

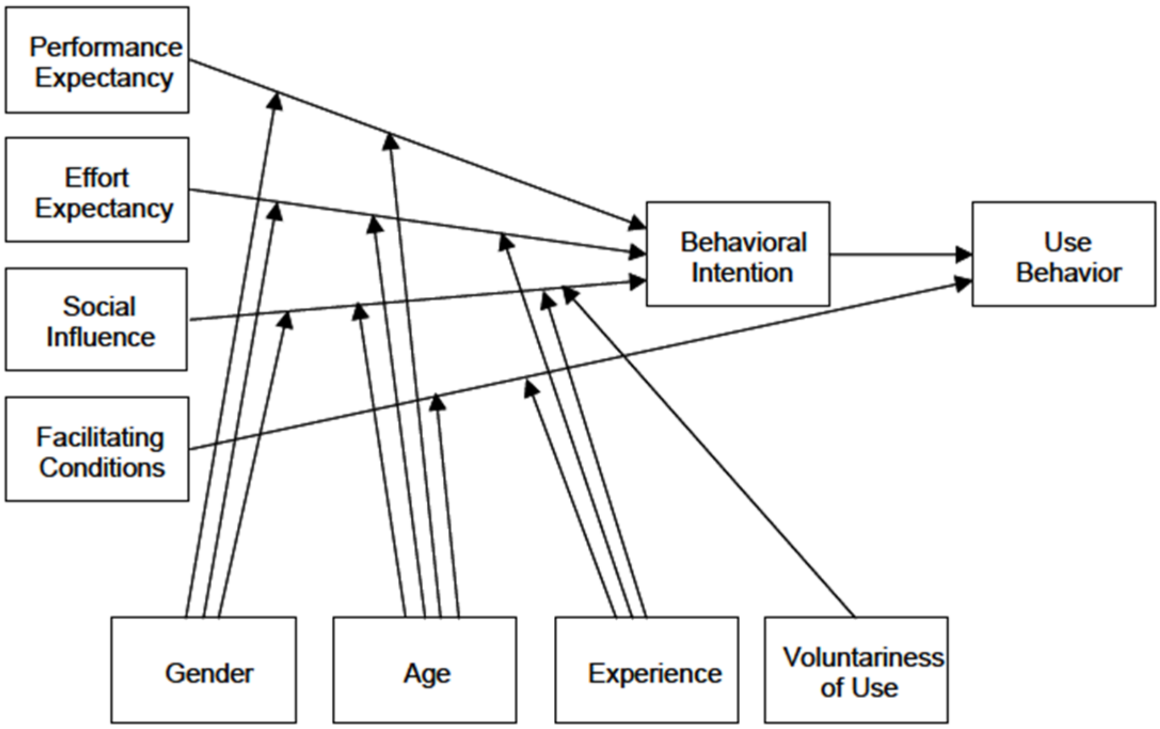

Figure 14: UTAUT model, (Venkatesh et al 2003)

Venkatesh et al. (2003) conducted a research using the data from four organizations in order to integrate all the models into a unified model as the Unified Theory of Acceptance and use of Technology (UTAUT1). This model theorizes that Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions are direct determinants of two dependent variables - Behaviour Intention and User Behaviour. All the determinants of the model were found to be significant and predicted the behavioural intention and its consequent use of the technology. Furthermore, individual differences such as gender, age, experience and voluntariness of use are considered as the moderators of the four constructs in the UTAUT1 model.

3.8 Unified Theory of Acceptance and use of Technology UTAUT2

Quite recently, Venkatesh et al. (2012) modified the UTAUT1 model based on their findings from a research conducted in Hong Kong. They used three new constructs in proposing the new UTAUT2 model. These three new constructs were Hedonic Motivation, Price and Habit as illustrated in Figure 15. Venkatesh et al. (2012) claimed that the suggested additions in UTAUT2 exhibited 70% of variance explained in behavioural intention and 50% of variance in technology use (Guinness, 2015; Raman & Don, 2013; Slade et al., 2013).

(Venkatesh et al., 2012) developed the UTAUT2 model after making consistent upgrades to the original UTAUT model. The main objective of developing UTAUT2 was to cater to new constructs which could better explain the new emerging technologies giving rise to new consumer technology use. Venkatesh et al. (2012) believed that theories that focused on explicit context and identified relevant predictors were vital to understanding technology acceptance and its use. Johns (2006) posit that new contexts can foster modifications in technology acceptance theories, and will invalidate originally theorized relationships to be nonsignificant, by creating new relationships.

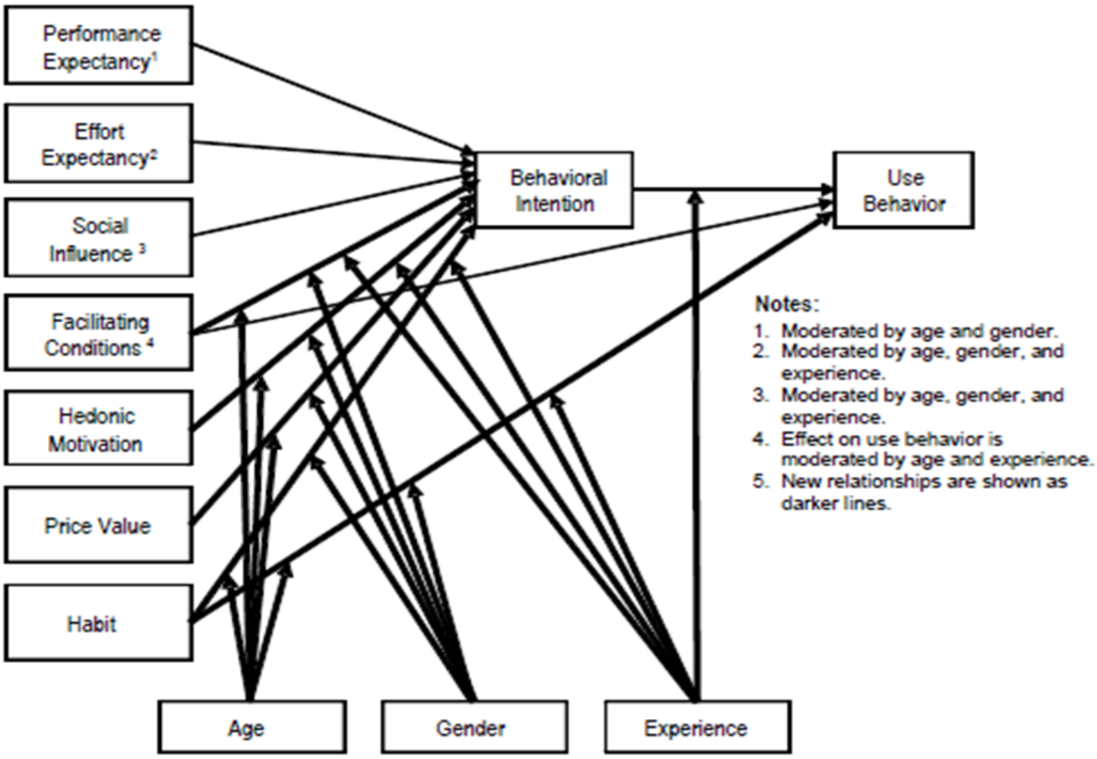

Figure 15: UTAUT2 model, (Venkatesh et al 2012)

There are many studies which have adopted the UTAUT1 or UTAUT2 models by extending the constructs and often introducing new constructs. The Meta-Analysis section of the literature review chapter (Table 8) of this thesis highlights the numerous studies which had adopted and improvised the UTAUT2 constructs. Most of the studies done using these models modify the research to suit the context of the study. This research has also extended the UTAUT2 model to suit the context of assessing the student's acceptance at a university cohort. The following section discusses the adopted UTAUT2 model in detail.

3.9 UTAUT2 Constructs and Moderators:

This study incorporates the UTAUT2 model with seven core independent determinants predicting the eighth dependent variables construct. This dependent variables construct is the Behaviour Intention to adopt Smartphones as learning tools, as shown in Figure 11. The UTUAT2 model also allows researchers to analyse moderators that either amplify or constrain the effects of core determinants. The eight key constructs that influence intention to use a technology are as follows:

1. **Performance Expectancy (PE):** the degree to which using a technology is expected to enhance the performance.
2. **Effort Expectancy (EE):** the degree of ease associated with the use of technology
3. **Social Influence (SI):** the extent to which the user is influenced socially in his use of technology
4. **Facilitating Conditions (FC):** refers to the resources and support available to use technology
5. **Hedonic Motivation (HM):** the pleasure derived from using the technology
6. **Price (PR):** cognitive trade-off between perceived benefits of using technology and the costs for using them
7. **Habit (HA):** the extent to which the user believes technology use is instinctive or habitual

3.9.1 Performance Expectancy (PE):

Performance expectancy is defined as the degree to which the student believes that using Smartphones will help him to accomplish the various academic tasks in an educational context. Of all the constructs of the UTAUT2 model which aim to assess technology acceptance and usage, Performance expectancy is the strongest among them all (Pahnila, Siponen, & Zheng, 2011; Venkatesh et al., 2003). Many research studies have reported similar concurrent findings of Performance acceptancy as the strongest predictor of technology acceptance and use behaviour (Adell, 2010; Alrawashdeh et al., 2012; Oshlyansky et al., 2007; Pahnila et al., 2011; Raman & Don, 2013; Venkatesh et al., 2012; Yu, 2012).

When using the Smartphone, a student expects the device to improve academic performance as well as academic scores (Yang, Chiang, Liu, Wen, & Chuang, 2010). AlAwadhi and Morris (2008) researched students' intentions to use Smartphones for electronic resources and found that Performance expectancy was a strong determinant. A similar study performed to assess the intentions of students to use instant messaging on mobile devices, also concluded that Performance expectancy was a key determinant of behavioural intentions (Lin, Chan, & Jin, 2004; Yang et al., 2010). Performance expectancy was adopted form the TAM, MM, MPCU, IDT model as shown in Table 14

Table 14: Performance Expectancy (Venkatesh et al., 2003)

CONSTRUCTS	MODEL
Perceived usefulness	TAM/TAM2 and C-TAM-TPB
Extrinsic motivation MM	MM
Job-fit MPCU	MPCU
Relative advantage IDT	IDT
Outcome expectations SCT	SCT

This research survey instrument will measure Performance Expectancy (PE) with six questions that mainly illustrate the accomplishment, usefulness and assistance offered by Smartphones in improving academic performance. All the questions of the survey instrument were adopted from highly cited research findings in the field of using UTAUT model for technology acceptance. Furthermore, the questionnaire was only slightly modified from the adopted instrument to better suit the context, content and sample population of this research.

Performance expectancy is expected to be moderated by gender, educational level and the two contexts of this study and the effect of each moderator will be assessed as a set of hypotheses formulated in the later part of this chapter.

3.9.2 Effort Expectancy (EE):

Effort Expectancy (EE) for this research purpose is defined as the degree of ease associated with the use of the Smartphone as a mobile learning tool. Similar constructs in other technology models and theories form semantic viewpoints which include perceived ease of use (Technology Acceptance Model), complexity (PC utilization model) and Degree of complexity (diffusion theory). Furthermore, Effort expectancy defines that the user will have to exert less efforts to operate Smartphones for learning. An effortless system is expected to get better integrated among the users of all ages and genders (Venkatesh et al., 2003).

Effort expectancy is expected to play a bigger role in assessing Smartphones as learning tools, as they are intuitive with easy to use interfaces, gesture driven controls, touch screen user interface, smart controls and sensors, all of which greatly accentuate the user's ease in accessing and interacting with the tool (Wang et al., 2014). The frequent use and rampant ubiquities of this device have made it a very familiar technology among all ages. Coupled with the ability to execute many day to day tasks such as emailing, communication, checking the weather, entertainment, taking pictures, etc., the Smartphone can assist with critical tasks such as GPS maps (Lee & Son, 2013; Nesaratnam & Taherzadeh, 2014).

Performance Expectancy was derived from five constructs from different human behavioural models: perceived usefulness (TAM and C-TAM-TPB), intrinsic motivation (MM), job fit (MPCU), relative advantage (IDT), and outcome expectations (SCT) (Venkatesh et al., 2003; Wang et al., 2009) as shown in Table 15.

Table 15: Constructors of effort expectancy (Venkatesh et al., 2003)

CONSTRUCTS	MODEL
Perceived ease of use	TAM/TAM2
Complexity	MPCU
Ease of Use	IDT

This construct will be measured by asking five questions based on the common current literature set and this construct is also expected to be moderated by gender differences, varied educational levels and the two contexts of this research.

3.9.3 Social Influence (SI):

Social Influence is the degree to which an individual perceives that others believe he/she should use the new system. Social influence, a factor derived from the UTAUT, is a social factor or social norm in which the user perceives that social relationships like family, friends or close peers influence his beliefs that he or she should use a technology (in this case, the Smartphone) (Venkatesh et al., 2012).

As humans are always influenced by the environments in which they interact socially and culturally, it is reasonable to say that social influence moulds an individual's behaviour. These influencing factors force the user to react to how others will view him as a result of using the technology. Venkatesh and Davis in their 2000 publication (Venkatesh & Davis, 2000) highlighted the importance of social factors as they become more significant in mandated environments. The effect of adopting a technology in an obligatory adoption environment, is that the social influence appears to be significant only in the early stages and it tends to diminish over time.

The role of Social Influence is complex, which shape individual perception about a particular technology. This was studied in two separate research projects by (Venkatesh et al., 2003; Venkatesh et al., 2012). Both assessed the impact of Social Influence on Behavioural Intention in the UTAUT1 and UTUAT2 models. Social Influence was found to be a direct determinant on influencing Behavioural Intention in mandatory or voluntary contexts.

In a similar study conducted by AlAwadhi and Morris (2008) using UTAUT, the acceptance of e-government services was assessed and it was concluded that peer influence on users is significant. However this study posited that the same peer influence tends to have reduced effect in situations where they have limited experience with mobile devices. The researchers agreed on the importance of guaranteeing positive experiences with any technology integration, as peer influence can be an important determinant in the use of technology.

When an individual considers adopting a new technology, he is usually influenced by other individuals, and primarily by family and close friends. If these social influences give him a positive view of the use of Smartphones, then the probability of the individual adopting this use becomes significantly high. Previous studies associated with Smartphones have also indicated that social influence was important for technology adoption (Admiraal et al., 2013; Alrawashdeh et al., 2012; Fehrenbacher, 2013; Raman & Don, 2013; Slade et al., 2013; Venkatesh et al., 2012). The UTAUT2 model incorporates three constructs from existing technology acceptance models to capture the concept of social influence: subjective norm (TRA, TAM2, TPB and C-TAM-TPB), social factors (MPCU) and image (IDT) (Venkatesh et al., 2003) as shown in the Table 16.

Table 16: Constructors of social influence (Venkatesh et al., 2003)

CONSTRUCTS	MODEL
Subjective Norm	TRA, TAM2, TPB/DTPB, and C-TAM-TPB
Social Influence	MPCU
Image	IDT

Research suggests that in a mandatory context social influence becomes an important factor in user acceptance of information systems/technology (Davis et al., 1989; Venkatesh et al., 2003). In a similar research conducted by Venkatesh et al. (2012), they posit that social influence is strongest during the early stages of technology integration and tends to decreases as the use progress over time. This research will use twelve questions adopted after conducting literature review, as discussed in the earlier Literature Review chapter of this dissertation.

3.9.4 Facilitating Conditions (FC) Peer Support:

Facilitating Conditions, in the age of digital technologies, represent a broad spectrum of technical support, learning environments, systems, regulations etc. Many research studies have attempted to assess each one of these alone or in combinations. Cunningham and Duffy (1996) posit that processing information was the key to reconstructing knowledge using the paradigm of modelling and interaction since the inception of the computing age. During the contemporary era of digital communication technology with the increasing communication and digital social interaction the focus has shifted towards leveraging the association between mobile technology and learning. This has led to an acute need for the exploring of appropriate models of education and learning for the age of mobile technologies.

Facilitating conditions drawn from the UTAUT can be defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of a Smartphone (Venkatesh et al., 2012). When a user attempts to adopt a new technology he is expected to have some prior knowledge (Venkatesh et al., 2003; Zhou, 2008). The element of resource, technical support, prior knowledge and peer help can be explained by the facilitating condition construct. Facilitating conditions for a student to use the Smartphone as a learning device, is the presence of an organised technical support system, formal or informal, from his fellow classmates and peers at the university. This construct was adopted from the as Perceived Behavioural Control from TPB/DTPB and C-TAM-TPB as shown in the Table 17.

Table 17: Constructors of facilitating condition (Venkatesh et al., 2003)

CONSTRUCTS	MODEL
Perceived Behavioural Control	TPB/DTPB and C-TAM-TPB
Facilitating Conditions	MPCU
Compatibility	IDT

Triandis (1979) posits that a behaviour cannot occur if the objective conditions in the environment prevent it. In the case of mobile technologies, the aspect of conducive environment had demonstrated a positive correlation with facilitating conditions and behavioural intention (Wu, Tao, & Yang, 2007). In an educational environment which fosters learning using mobile devices like Smartphones, the satisfaction of the learner is affected by his perception of available technical support, learning content, functionality of personal devices, peer help and encouragement (Venkatesh, Brown, Maruping, & Bala, 2008). Many studies confer that technology acceptance is correlated to the facilitating conditions construct as an important factor leading to new technology acceptance

(Venkatesh et al., 2012; Zhou, Lu, & Wang, 2010). Venkatesh and Davis (2000) posit in their research that facilitating conditions might sometimes conflict with the effort expectancy construct in the Unified Theory of Acceptance and Use of Technology (UTAUT).

Venkatesh and Davis (2000) research concludes that the significance of facilitating conditions might be minimized when the constructs Performance expectancy and Effort expectancy are both present (Venkatesh & Davis, 2000; Venkatesh et al., 2003). The literature review of previous studies indicates that providing resources, training, and information to users has a significant effect on technology usage and on the behavioural intentions to use any technology. With the above mentioned reasons, Facilitating conditions appears to be an essential construct to determine the acceptance of the Smartphone as a learning tool using the UTUAT2 model.

Venkatesh and Davis (2000) claim that facilitating conditions are more important for Women than for Men as he concludes that Women are more process-oriented than Men. This research believes that the contexts of this study (College of Engineering-CX1 and College of Education CX2) will be moderated by facilitating conditions. Furthermore, the educational level of the students (undergraduate (UG) and postgraduate (PG)) will also moderate the facilitating conditions for the use of the Smartphone as a learning tool.

This research is motivated by the theory of Connectivism proposed by Siemens (2005) and attempts to leverage the advantage of the ubiquity and 24/7 connectivity of Smartphones for digital generation learners. Furthermore, this research proposes to assess the redefined role of the Facilitating Conditions Construct of the UTAUT2 model by replacing the original items with that of connectivity with Smartphone for mobile learning items.

This study used sixteen questions to extract the effect of facilitating conditions on behaviour intention to use Smartphone as a mobile learning tool. This study redefined the Facilitating conditions construct with the ability of the Smartphone to connect with peers, university friends and colleagues.

3.9.5 Hedonic Motivation (HM):

Hedonic motivation is where the user takes a pleasurable experience and seeks sensations on multiple sensory channels (Igbaria, Iivari, & Maragahh, 1995). Technology designers exploit this phenomenon and encourage the user to extend the use by providing hedonic design, functionality, personalisation with multi-utilitarian functionality. Research studies, conducted in the area of Information Science (IS) have found that hedonic motivation is one of the important drivers behind the adoption of technologies. The use of technology both directly or indirectly are found to be closely related to Intrinsic motivation and perceived enjoyment (Lee, Cheung, & Chen, 2005).

Historically, the hedonic nature of accepting a technology or a system is an important factor in the Technology Acceptance Model (TAM). Many research findings using TAM have accepted this fact after studying the hedonic nature of technology on consumer enjoyment, and hence have posited that hedonic motivation is an important determinant of technology acceptance and use (Brown & Venkatesh, 2005; Lee et al., 2005; Lowry, Gaskin, Twyman, Hammer, & Roberts, 2012; Thong, Hong, & Tam, 2006); Childers et al. 2001). Perceived enjoyment basically was drawn from the Technology Acceptance Model 3 (TAM3) which is defined as the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, (Venkatesh et al., 2012) as shown in Table 18.

Table 18: Constructors of hedonic motivation

CONSTRUCTS	MODEL
Perceived Behavioural Control	TPB/DTPB and C-TAM-TPB
Intrinsic Motivation	TAM,
Utilitarian Motivation	IDT
CA	CA (Cognitive absorption) Agarwal and Karahanna (2000)

The intention to use new technology was found to be significantly affected by Perceived enjoyment (Davis, 1993). Previous studies documented the contextual effects of the perceived enjoyment of using Smartphones to access mobile Internet (Shin, 2007; Song &

Han, 2009). Van der Heijden (2004) conducted a research involving 665 participants and the results confirmed that hedonic context is a powerful and appropriate predictor of Behaviour Intention (BI).

Many previous studies suggest a strong significant correlation between user satisfaction, pleasure and the actual use of technology (Igbaria et al., 1995; Thong et al., 2006). Park and Lee (2011) have noticed a positive role of perceived enjoyment with the initial adoption and continued use of web-based information systems and entertainment devices. Previous research concluded that perceived enjoyment with the use of technology may have a stronger effect on IT usage than the other factors such as perceived ease of use and perceived usefulness (Turel, Serenko, & Giles, 2011),.

3.9.6 Price (PR)

The origins of price value construct in the UTAUT2 model comes from the perceived value which is an important predictor of the user's perceived worth of using a technology against its benefits (Dodds, Monroe, & Grewal, 1991). Venkatesh et al. (2012) included *Price Value* (PV) as a construct in UTAUT2 due to existent monetary costs for using a technology in a consumer context. From a user's point of view the definition of the price value is a trade-off between the benefits and sacrifices (Zeithaml, 1988, p. 14) of using a particular technology. This concept was adopted to analyse users' adoption of emerging technologies like Smartphones, Tablets etc.

Additionally, the costs of maintaining a Smartphone, its accessories and periodic operation costs such as data plans and phone bills, are also included within this construct. Furthermore, the Smartphone is deemed acceptable by the student if the operation and maintenance cost of using it for education is relatively cheaper or exerts almost no extra cost to his regular bill. This can reinforce a positive experience for the student. This factor can further encourage the user's peers and friends to use the Smartphone for education.

Price Value refers to the cognitive trade-off between the monetary costs and the benefits of using a particular technology or application (Venkatesh et al., 2012). This means that price value is positive when the identified benefits of using a technology in question is identified to be greater than the actual costs. Furthermore, the added value benefit of price has a positive impact on behaviour intentions to use a technology (Pitchayadejanant, 2011).

In the terminology of a business marketing context, the perspective of price value has a dual connotation: the monetary cost and the nonmonetary cost. Monetary cost is the identified value against the price paid and the nonmonetary cost refers to the value against the efforts and time expended (Pitchayadejanant, 2011). In this research, the concept of price value is used to describe suitability between the costs of using Smartphones against the benefits that can be acquired through them for education and learning.

Venkatesh et al. (2012) advise that the cost and pricing structure could have significant impact on the use of technology. While Ulaga and Eggert (2003) claim that value can be a good predictor of behavioural intentions. Technologies are on the path of doubling their capacity every year and the cost to own the same is being reduced by half or more (Kenney & Von Burg, 1999). A recent survey of mobile phone usage in developing countries predicts that more young and old generations of users will affect Smartphone prices and data plan costs continue to slide downwards (Boksberger & Melsen, 2011).

This forecasted usage is going to impact the individual's choice to own and maintain the Smartphone. In this research, the price value refers to the monetary values to assess the student's acceptances of Smartphones for education.

3.9.7 Habit (HB)

Habit is characterised as an automatic behaviour as opposed to a clear intentional behaviour (Limayem & Hirt, 2003). A person gets habituated when he or she uses a tool or technology with short-term repetitions, reinforcement, clarity of the concept, interest, and ability to learn (Triandis, 1979). Habit differs from reflexes in that, to become a habit, an activity requires learning that is composed of several factors such as a number of short-term repetitions, reinforcement, clarity of the situation, interest, and ability to learn (Triandis, 1979).

Mobile technologies are designed to fulfil the most important need of humans to communicate independently. Smartphone innovations are devised for the convenience and productivity of users and they are continuously redesigned to disrupt and replace electronic tools such as cameras, DVD / video players, mp3 players, camcorders, voice recorders, simple browsers, instant messaging systems, email and text messaging systems, GPS devices, radios, gaming devices and now laptops. The Smartphone, as a miniaturized combination of these devices, is a simpler, easier and cheaper device as compared to the rather bulky, cumbersome and expensive technological gadgets previously listed.

In a research conducted by (Oulasvirta, Rattenbury, Ma, & Raita, 2012), 12 students were asked to each keep a diary to record all their activities for the first 2 weeks. The results reveal that the strongest habitual usage for activities were related to the use of Internet, checking e-mails, Facebook, update feeds, and reading news headlines. Oulasvirta et al. (2012) concluded that habits were concentrated to the ‘‘empty’’ moments of day and most often those habits were related to motivators such as entertainment, social networking and killing time.

Wood and Neal (2007) claim that the triggers of habitual behaviours can be external and internal states that are partially related to current situations. Spencer (1890) posits that habits have both positive and negative effects on behaviour and they are necessary for the control of action. Habit or automaticity enables learners to multitask and acquire complex skills; they also help them to retain adequate performance for innovative methods. Smartphone users are inherently habituated to checking their devices as compared to checking laptops, however the use of Smartphones is significantly shorter in duration and more uniformly spread throughout the day (Oulasvirta et al., 2012).

The frequent checking habits of Smartphone users increases overall phone use, especially through its applications. Fogg and Hreha (2010) posit that information seeking and frequent access to dynamic content can induce persuasive habits. The theory proposed by Wood and Neal (2007) suggests that the habit of Smartphone usage is tightly associated with the persuasive trigger of frequent use.

This research will analyse the direct effect of habit on behaviour intention, as suggested in the previous literature (Kroeze, Werkman, & Brug, 2006; Verplanken & Orbell, 2003).

3.9.8 Behaviour Intention (BI)

Fishbein and Ajzen (1975) describe Behavioural Intention (BI) as the intensity of an individual's intention to complete a specific behaviour and hence predict actual usage (Davis et al., 1989). This construct originates from the Theory of Reasoned Action (TRA). The theory of reasoned action (Ajzen & Fishbein, 1980) has been widely used across the social sciences as a basis to study behaviour intention.

The earliest inception of Behavioural Intention comes from the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB). Both TBP and TAM posits Behavioural Intention as the precursor to *Usage* behaviour (Davis et al., 1989). It can be further stated that Behavioural Intention (BI) is the most proximate predictor of an actual behaviour (Ajzen, 1991). This connection of Behaviour Intention and actual Usage has been extensively studied and verified in the field of information Sciences.

All the Technology Acceptance Models find their construct basis and origins from psychological theories, which posit that individual behaviour is predictable and influenced by individual intention. The Unified Theory of Acceptance models (UTAUT1 and UTAUT2) also contended and proved that behavioural intention had significant influence on technology usage (Venkatesh et al., 2003). In a study conducted by Venkatesh et al. (2003) the use of the Unified Theory of Acceptance and Use of Technology (UTAUT2) model out performed eight previous technology acceptance models in predicting the factors influencing behavioral intention and actual use behaviour.

The strength of the UTUAT2 model is its explanatory power in a particular context. This model is able to account for about 70 % of the variance in behavioral intention to use a technology. This study confirmed the influence of Performance Expectancy, Effort Expectancy, Facilitating Conditions, Hedonic motivation, Price value and Habit on Behavioural Intention. The UTAUT2 is a powerful and parsimonious model that helps to understand technology adoption behaviour (Venkatesh et al., 2003; Venkatesh et al., 2012).

Hence, if the usage is mandatory it is highly recommended to examine behavioural intention to use a technology. In this study, user behaviour intention is used as the indicator of user acceptance.

3.9.9 Moderators of the study

This study replaces the two original moderators of UTAUT2, ‘Age’ and ‘Experience’, with ‘Educational Level’ (UG, MS and PhD) and ‘Contexts’ (CX1 and CX2) of the University respectively, as shown in Figure 16. The study retains the ‘Gender’ moderator (Men and Women). The reason behind using the above said moderators is that their presence is cohesive with the aims of the study which propose to compare the two contexts of the same university.

It is also supposed that the students of CX1 use Smartphones differently than the students of CX2 and this forms the central hypothesis of this study. There are many studies which have empirically tested and proved the significance of the original moderators (Alrawashdeh et al., 2012; Fehrenbacher, 2013; Pahnila et al., 2011; Pheeraphuttharangkoon et al., 2014; Pitchayadejanant, 2011; Raman & Don, 2013; Venkatesh et al., 2012; Xu, 2014; Yang, 2013).

Kirkwood and Price (2006) states that in addition to understanding the digital tools and technologies students use, it is also important to recognize the educational purposes, pedagogies and criteria that provide technology acceptance and integration. The study of the intention to use Smartphones in an educational context with relevant moderators, will advance our understanding of their integration in academia and help in developing new pedagogies that reflect that integration.

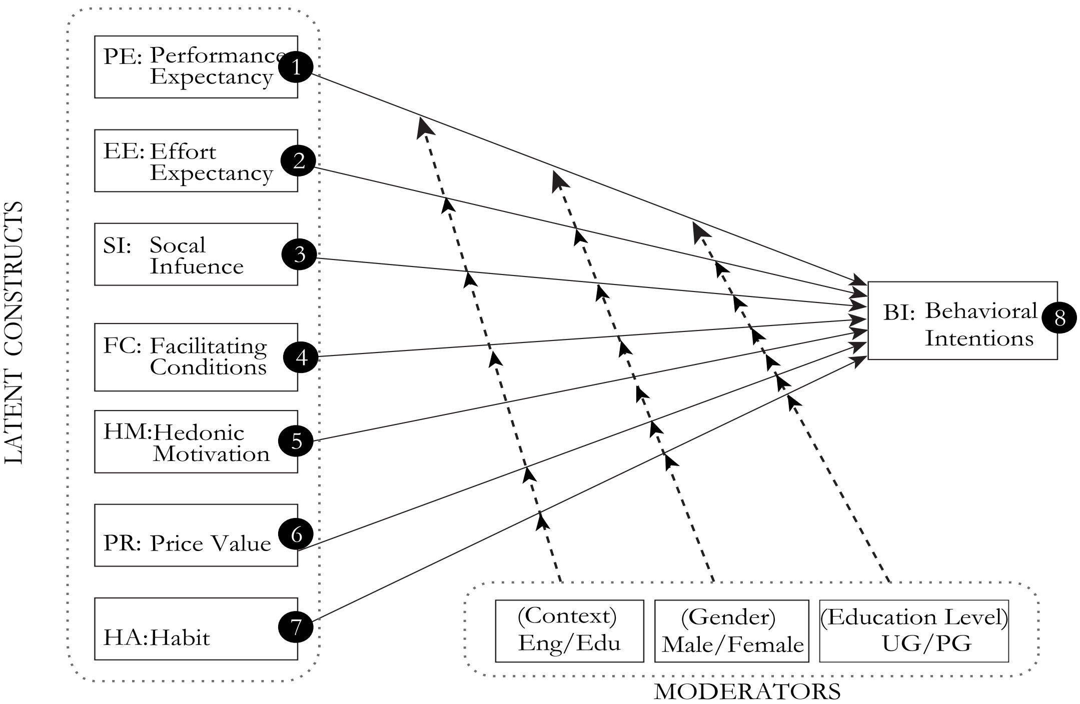

Figure 16: UTAUT2 model, after (Venkatesh et al., 2012)

3.9.10 Gender Moderator:

Because the two contexts of the study had significant gender dissimilarity (Male: CX1= 77%, CX2=33% and Female CX1=23%, CX2=67%), it was imperative to include this moderator to rule out the possibility of its bias. Furthermore, gender as a moderator was studied as a principal moderator in all the studies incorporating the UTAUT2 model (Alrawashdeh et al., 2012; Pahnila et al., 2011; Venkatesh et al., 2012; Xu, 2014; Yang, 2013).

The two elementary theories which constitute the foundation of UTAUT model are the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TBP) which make Gender an effective moderator. Venkatesh and Davis (2000) posited the effect of gender after conducting a longitudinal investigation based on TAM and TBP; and the study results demonstrated significant influence. This study concluded that Men and Women showed different levels of acceptance when they evaluated and adopted new technologies. Furthermore, this research found that Men showed higher significance in their attitude towards behaviour intention, while Women showed more significance with subjective norms and perceived behavioural control.

This research reported stronger results in Men when they measured perceived usefulness while the effect of Women gender was significant when they measured ease of use. This research also found that Men were clearly more influenced by perceived usefulness, whereas the effect of the Women gender tended to be more by ease of use. In another study conducted by Venkatesh et al. (2003), using the UTAUT1 model established that all the hypotheses of this model were significantly moderated by the effect of gender. This research reported that the effect of the independent variable Performance Expectancy and dependent variable Behavioural Intention was stronger for Men, while the relationship between Effort expectancy and the intention to use technology was more significant for Women. When the use of the technology was made mandatory on Women, the effect of independent variable ‘social influence’ and dependent variable ‘use behaviour’ showed significance.

There are many studies that have conducted technology acceptance studies and found gender as the principal moderating effect (Abu-Al-Aish & Love, 2013; Alrawashdeh et al., 2012; Pahnila et al., 2011; Raman & Don, 2013; Slade et al., 2013; Venkatesh et al., 2012; Wang et al., 2009; Xu, 2014; Yang, 2013; Yu, 2012). It can be concluded that gender plays an important and critical role as a moderating effect in the behaviour intention of using a technology. Hence this study incorporates the effect of gender as a moderator that effects the acceptance of the Smartphone as a learning tool. The two gender groups as moderators for this study will be Male (M) and Female (F).

3.9.11 Educational of Level Moderator:

A review of the literature on using educational level as a moderator indicates that educational levels influence the acceptance of technology. Chen (2011) posits that educational level as a moderating effect has an inherent correlation with the cultural settings of the study in context. Another study, conducted in China, investigated the effects of moderating variables such as gender, education, and past experience of the Internet and concluded that they provided a greater understanding of mobile technology acceptance patterns (Park, Yang, & Lehto, 2007). This study also revealed that the UTAUT model explained that higher education group members mainly shaped their attitude towards mobile technology through social influence. This study also highlights the significant role of performance expectancy, which plays a meaningful factor in determining the behaviour intention to use a technology with a highly educated user.

Another study conducted on the adoption of e-governance, using the UTAUT1 model, argues that there are differences in gender and education levels among the users using Information Computing Technology (AlAwadhi & Morris, 2008). This indicator has its limitations in academic settings. The use of technology was notably influenced by the educational level of the population. Studies that used educational level as a moderator, had shown differences among groups with educational level as a moderator (AlAwadhi & Morris, 2008; Van Dijk, Peters, & Ebbers, 2008).

The clustering of this moderator was mainly into two groups: Undergraduate (UG) and Post Graduates (PG) - with the Masters and PhD students clustered under PG. The demographic data collected from the survey shows that the undergraduate students were mostly in the same age group while the cluster from PG students (masters and PhD) were also formed mainly under one age group.

3.10 Contexts Moderator

As explained earlier, the College of Engineering (CX1) and College of Education (CX2) are the two primary contexts of this research and are from the same university. They are chosen according to the contrasting differences in their programs, curriculums, teaching pedagogies, student aptitudes, required skills and length of studies, etc. By comparing and assessing the moderation by these three measures, a rich understanding can be acquired of the behaviour intention when using Smartphones as learning tools between the two contexts. The comparative analysis of these two contexts can also be compared to similar cohorts to assess the parameters that drive the acceptance of Smartphones in a university setting.

Jeng, Wu, Huang, Tan, and Yang (2010) states that learning using mobile devices creates a microchasm, which emphasises the provision of learning content at the right time and place From the literature review conducted by this research and the data collected on the use of Smartphones by the sample population of this study, it was shown that 98% of the students use Smartphones extensively. The goal of this study is to assess the contextual use of the Smartphone as a learning tool in a university setting. The primary foundation of this contextual comparison is based on the premise that Smartphones are extremely personal and are used uniquely by individuals according to their needs (Gómez, Zervas, Sampson, & Fabregat, 2014; Jeng et al., 2010).

The multi-dimensional use of Smartphones gave rise to context aware learning, just in time learning and ubiquitous learning. These styles utilise an effective learning management system that adapts and personalizes the learning content to fit according to the needs of a learner, his learning style, his location, and connects the learner to a larger domain of learning community (Wu, Chang, Chang, Liu, & Heh, 2008).

Furthermore, it is also believed that a comparative analysis and understanding of the Smartphone acceptance among the two contexts (College of Engineering and College of Education) will aid in the acceptance of Smartphones as learning tools. A context aware system also demands that the learning content delivered through Smartphones requires customised content design and at the same time structured technology integration (Rogers, 2000). This research strongly believes that the key benefits of this approach are that the learners are put in the centre when receiving learning experiences that are customised to their particular educational needs. This is in order to maximize their satisfaction, suit their pace of learning as well as enable an effective learning experience (Gómez et al., 2014).

3.10.1 College of Engineering Context (CX1):

The use of technology has always been the primary attraction in the field of engineering education. Engineering and technology based courses are often mathematically and graphically intensive (Frolik & Zum, 2005). From the early use of slide rules to scientific calculators, using technology is inherently part of Engineering teaching and learning. By the end of the 20th century, technologies related to communications and the Internet led to a revolution giving way to highly interactive, simulation driven e-learning courses, 3D visualization, and advanced data visualization, etc., thus facilitating teaching and learning in Engineering education (American Society for Engineering Education, 2013).

Redondo, Fonseca, Sánchez, and Navarro (2013) claim that, given their induction in engineering education, there have been very few studies to show their effectiveness in an academic environment. The integration of technologies in the field of education previously lacked a systematic approach (Abhyankar & Ganapathy, 2014). Nesaratnam and Taherzadeh (2014) highlight that the inception of Smartphone technologies have the potential to impact engineering education. They are equipped with better communication, augmented reality, touch screens interaction, advanced and robust operating systems, access to super computers (Boulos, Wheeler, Tavares, & Jones, 2011). No other technology contains such a collection of features that helps engineering students solve complex engineering problems by using cloud-based computing and simulations, augmenting engineering concepts, simulating virtual reality, etc.

Moreover, built-in sensors along with high resolution cameras can revolutionize the development of mobile applications (Kurkovsky, 2012) by creating state-of-the-art scientific calculators, mobile computing platforms, computer aided designing (CAD) data visualizers, engineering simulators, augmented virtual reality scientific experiments, data loggers and control devices (Heggen, Omokaro, & Payton, 2012). Smartphones offer excellent opportunities as a single stop shop tool for engineering and technology measurement, calculation, simulation, visualization and augmentation, to name a few.

3.10.2 College of Education Context (CX2):

The College of education provides teaching education programmes and helps develop teacher proficiency and competence in order to enable the potential educator to teach from pre-primary to higher education levels. This body of education concentrates on teaching skills, sound pedagogical theories and professional skills; and is often also termed as teacher education. The program inherently focuses on human behaviour, psychology and cognitive skills. Its activities include individual projects, qualitative assessments, case studies and the conducting of interviews. Substantial research opinions suggest a significant impact of teachers on the quality of teaching and learning (Kane & Francis, 2013).

The quality of teacher education has become ever more important but there continue to be doubts about whether the systems and programs which educate and prepare these professionals are robust enough to meet the challenges of the future generation's learning needs (Darling-Hammond, 2000). Furthermore, this article illustrates that education school programs not only recommend that teachers should significantly change the way classrooms are run, but they also assert that a "revolutionary change" is needed. The College of Education, like any other body of knowledge, can only work on professional commitments that are susceptible to change (Kukulska-Hulme, 2012).

This study highlighted the application of handheld devices in colleges of education, which could remove the requirement for geographical proximities and encourage collaborative learning. Liu et al. (2010) also posits that the use of mobile devices should extend learning beyond conventional classrooms. Issues surrounding the adoption of mobile technologies by teachers have risen due to the inadequate investigation of their advantages (Kukulska-Hulme, 2009; Schuck, Aubusson, Kearney, & Burden, 2013). With the rise of using mobile devices as learning tools, teacher education programs need to use creative learning initiatives where mobile learning is understood theoretically, pedagogically and academically (Newhouse, Williams, & Pearson, 2006). Mobile devices are not only attractive because of their mobility, but are also rendered academically relevant due to developments such as geospatial technologies, image and video capture, search capabilities, etc. (Martin & Ertzberger, 2013).

Using the Smartphone for learning is highly flexible, provides revolutionary learning styles and bridges economic, social, financial and ethnic divides. The findings of this research should be applicable across a range of similar contexts, programs and conditions, etc. The research used the Unified Theory of Acceptance and Use of Technology (UTAUT2) to compare the two contexts in order to understand Smartphone integration as a learning tool. After a detailed literature review of differences between the two contexts of this study, the following distinctions were highlighted in Table 19 for comparative study.

Table 19: Engineering Vs Education contextual difference

College of Engineering: CX1	College of Education: CX2
Engineering: Technology Intense	Social Science: Theoretical
Problem Solving	Human Behaviour
Design Oriented	Human Psychology
Analytically Driven	Teaching and Learning
Collaborative	Projects and Observation
Laboratory Activities	Interviews
Modelling	Case Studies
Simulation	Manual Data Logging
Data Logging	Qualitative
Quantitative	

3.11 Hypothesis Development

Due to the complexity of the large number of hypotheses required to be tested, this research divided them all into four sets (Set-I, II, II and IV) by grouping them as per the study's objectives of this research. The fundamental objectives of this research are to:

1. empirically assess the acceptance of the Smartphone as a mobile learning tool
2. to assess the **significance of UTAUT2** model parameters which derive the acceptance of the Smartphone as a mobile learning tool
3. to assess the significance of **gender** as a moderator in the acceptance of the Smartphone as a mobile learning tool
4. to assess the significance of **context** as a moderator in the acceptance of the Smartphone as a mobile learning tool
5. to assess the significance of **educational level** as a moderator in the acceptance of the Smartphone as a mobile learning tool

6. to assess the **Intra moderator (gender, educational level and Context)** effect and its significance between the two contexts (CX1 and CX2) in the acceptance of the Smartphone as a mobile learning tool
7. to assess the **Inter moderator (gender and educational level Context)** effect and its significance between the two contexts (CX1 and CX2) in the acceptance of the Smartphone as a mobile learning tool

Based on the seven objectives of this research as mentioned above, this study categorised the research hypothesis into four sets as mentioned below. Also, as mentioned earlier, this study focuses on the two contexts, the College of Engineering and the College of Education.

3.11.1 Hypothesis Sets:

1. **Set-I:** The **first** set of hypotheses will assess the **significance of UTAUT2** for the acceptance of the Smartphone as a mobile learning tool on the combined context sample population as listed in Table 6.
2. **Set-II:** The **second** set of hypotheses will assess the effect of the **moderators -** gender (M:W) and educational Level (UG:PG) - on the acceptance of the Smartphone as a mobile learning tool on the combined context sample population as listed in Table 7.
3. **Set-III:** The **third** set of hypotheses analysed the effect of **Intra**-contextual moderation between (CX1:CX2), gender (M:W) and educational levels (UG:PG) as listed in Table 8
4. **Set-IV:** The **fourth** and the final hypotheses will assess the **Inter**-contextual moderation between gender CX1(M):CX2(M), CX1(W):CX2(W), educational levels (CX1(UG):CX2(UG), CX1(PG):CX2(PG) as listed in Table 9

3.11.2 Set-I Hypothesis:

Significance of the UTAUT2 Constructs on Context Combined: In the first set hypothesis, this research postulates that the seven constructs significantly influence behavioural intention to adopt Smartphones for education for the total population of this study as shown in Table 20.

Table 20: Research Hypothesis Set-I, UTAUT2 Model significance

Constructs			(CX1+CX2)
BI	←	PE	**H1**
BI	←	EE	**H2**
BI	←	SI	**H3**
BI	←	FC	**H4**
BI	←	HM	**H5**
BI	←	PR	**H6**
BI	←	HA	**H7**

1. ***H1:*** *Performance Expectancy will have significant positive influence on Behaviour Intention*
2. ***H2:*** *Effort Expectancy will have significant positive influence on Behaviour Intention*
3. ***H3:*** *Social Influence will have significant positive influence on Behaviour Intention*
4. ***H4:*** *Facilitating Condition will have significant positive influence on Behaviour Intention*
5. ***H5:*** *Hedonic Motivation will have significant positive influence on Behaviour Intention*
6. ***H6:*** *Price Value will have significant positive influence on Behaviour Intention*
7. ***H7:*** *Habit will have significant positive influence on Behaviour Intention*

3.12.3 Set-II Hypothesis:

Effect of moderators on total population (CX1+CX2): Bem (1981) proposed the Gender Schema Theory, which posits that an individual's gender (Men or Women) affects their cognitive structure (a neural network of connections which guides the individual's perception). As explained above, gender remains the primary moderator in many studies which use the UTAUT2 model to assesses the acceptance of technology (Admiraal et al., 2013; Alrawashdeh et al., 2012; Fehrenbacher, 2013; Slade et al., 2013; Venkatesh et al., 2012; Xu, 2014; Yang, 2013).

There are many studies in the field of technology acceptance which have incorporated educational level (AlAwadhi & Morris, 2008; Foon & Fah, 2011; Jairak et al., 2009; Jaradat & Al Rababaa, 2013; Oshlyansky et al., 2007; Yap & Hii, 2009). These studies suggest that education level is a significant moderator that influences the behaviour intention to use technology.

Hence, this set of research hypothesizes that the seven constructs influencing behavioural intention to adopt Smartphones for education will be moderated differently by the **gender** and **educational level** on context combined as shown in Table 21.

1. Gender CX1+CX2 (M:W)
2. Educational Level CX1+CX2 (UG:PG)

Table 21: Research Hypothesis Set-II, Gender and Educational Level Moderation

Constructs			Gender	Educational Level
			M:W (CX1+CX2)	**UG:PG (CX1+CX2)**
BI	←	PE	**H8a**	**H8b**
BI	←	EE	**H9a**	**H9b**
BI	←	SI	**H10a**	**H10b**
BI	←	FC	**H11a**	**H11b**
BI	←	HM	**H12a**	**H12b**
BI	←	PR	**H13a**	**H13b**
BI	←	HA	**H14a**	**H14b**

1. ***H8a, H8b:*** *The effect of Performance Expectancy on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*

2. ***H9a, H9b:*** *The effect of Effort Expectancy on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*
3. ***H10a, H10b:*** *The effect of Social Influence on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*
4. ***H11a, H11b:*** *The effect of Facilitating Condition on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*
5. ***H12a, H12b:****The effect of Hedonic Motivation on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*
6. ***H13a, H13b:*** *The effect of Price on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*
7. ***H14a, H14b:*** *The effect of Habit on Behaviour Intention in the context combined will be moderated differently by gender (M:W) and educational level (UG:PG)*

3.12.4 Set-III Hypothesis:

<u>Intra</u> Contextual Comparison: Every activity takes place in a particular context. Equally, technologies are employed in specific contexts that determine how they are and can be used (Cole, 1998). Cole (1998) defines context in the following manner: “that which surrounds us” and “that which weaves together” In short, context is presented as an environment where students continually receive data that is interpreted as meaningful knowledge.

This set hypothesizes that the seven constructs influencing behavioural intention to adopt Smartphones for education will be <u>Intra</u> contextually moderated between the two contexts, gender and educational level as shown in Table 22.

1. Context (CX1:CX2)
2. Gender CX1(M:W):CX2(M:W)
3. Educational Level CX1(UG:PG):CX2(UG:PG)

Table 22: Research Hypothesis Set-III, Intra Contextual Moderation

Constructs			Context	Gender		Educational Level	
			CX1:CX2	**M:W (CX1)**	**M:W (CX2)**	**UG:PG (CX1)**	**UG:PG (CX2)**
BI	←	PE	**H15a**	**H15b**	**H15c**	**H15d**	**H15e**
BI	←	EE	**H16a**	**H16b**	**H16c**	**H16d**	**H16e**
BI	←	SI	**H17a**	**H17b**	**H17c**	**H17d**	**H17e**
BI	←	FC	**H18a**	**H18b**	**H18c**	**H18d**	**H18e**
BI	←	HM	**H19a**	**H19b**	**H19c**	**H19d**	**H19e**
BI	←	PR	**H20a**	**H20b**	**H20c**	**H20d**	**H20e**
BI	←	HA	**H21a**	**H21b**	**H21c**	**H21d**	**H21e**

1. ***H15a, H15b, H15c, H15d, H15e:*** *The effect of Performance Expectancy on Behaviour Intention will be moderated by context, gender and educational level within the same context group*
2. ***H16a, H16b, H16c, H16d, H16e:*** *The effect of Effort Expectancy on Behaviour Intention will be moderated by context, gender and educational level within the same context group*
3. ***H17a, H17b, H17c, H17d, H17e:*** *The effect of Social Influence on Behaviour Intention will be moderated by context, gender and educational level within the same context group*
4. ***H18a, H18b, H18c, H18d, H18e:*** *The effect of Facilitating Conditions on Behaviour Intention will be moderated by context, gender and educational level within the same context group*
5. ***H19a, H19b, H19c, H19d, H19e:*** *The effect of Hedonic Motivation on Behaviour Intention will be moderated by context, gender and educational level within the same context group*
6. ***H20a, H20b, H20c, H20d, H21e:*** *The effect of Price Value on Behaviour Intention will be moderated by context, gender and educational level within the same context group*

7. ***H21a, H21b, H21c, H21d, H21e:*** *The effect of Habit on Behaviour Intention will be moderated by context, gender and educational level within the same context group*

3.12.5 Set-IV Hypothesis:

Inter Contextual Comparison: Leadbeater (2004) argues that in the age of digital technology, students perceive learning as a personalised activity. This is due in part to ever evolving technologies which provide personalised entertainment and limitless applications. Smartphone technologies have liberated learners from cabled connections and have permitted access to knowledge without limiting the need to sit in a fixed location or a computer (Moustakas & Oliveira, 2012). As a result of these features, context as a moderator assumes greater importance.

This set hypothesizes that the seven constructs influencing behavioural intention to adopt Smartphones for education will be **Inter** contextually moderated between the same gender and same educational level as shown in Table 23.

Table 23: Research Hypothesis Set-IV, Inter Contextual Moderation

Constructs			Gender		Educational Level	
			CX1(M):CX2(M)	CX1(W):CX2(W)	CX1(UG):CX2(UG)	CX1(PG):CX2(PG)
BI	←	PE	**H22a**	**H22b**	**H22c**	**H22d**
BI	←	EE	**H23a**	**H23b**	**H23c**	**H23d**
BI	←	SI	**H24a**	**H24b**	**H24c**	**H24d**
BI	←	FC	**H25a**	**H25b**	**H25c**	**H25d**
BI	←	HM	**H26a**	**H26b**	**H26c**	**H26d**
BI	←	PR	**H27a**	**H27b**	**H27c**	**H27d**
BI	←	HA	**H28a**	**H28b**	**H28c**	**H28d**

1. Inter Gender Moderation
   i. CX1(M):CX2(M)
   ii. CX1(W):CX2(W)
2. Educational Level
   i. CX1(UG):CX2(UG)
   ii. CX1(PG):CX2(PG)

1. ***H22a, H22b, H22c, H22d:*** *The effect of Performance Expectancy on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*
2. ***H23a, H23b, H23c, H23d:*** *The effect of Effort Expectancy on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*
3. ***H24a, H24b, H24c, H24d:*** *The effect of Social Influence on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*
4. ***H25a, H25b, H25c, H25d:*** *The effect of Facilitating Conditions on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*
5. ***H26a, H26b, H26c, H26d:*** *The effect of Hedonic Motivation on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*
6. ***H27a, H27b, H27c, H27d:*** *The effect of Price Value on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*
7. ***H28a, H28b, H28c, H28d:*** *The effect of Habit on Behaviour Intention will be moderated by the same gender and the same educational level between the two contexts*

Chapter 4

4.0 Methodology

4.1 Introduction

This chapter discusses the research methodology used in this thesis, the adopted educational research paradigm, the process of developing the research instrument and the analytical techniques used to test the hypothesis as illustrated in Figure 17.

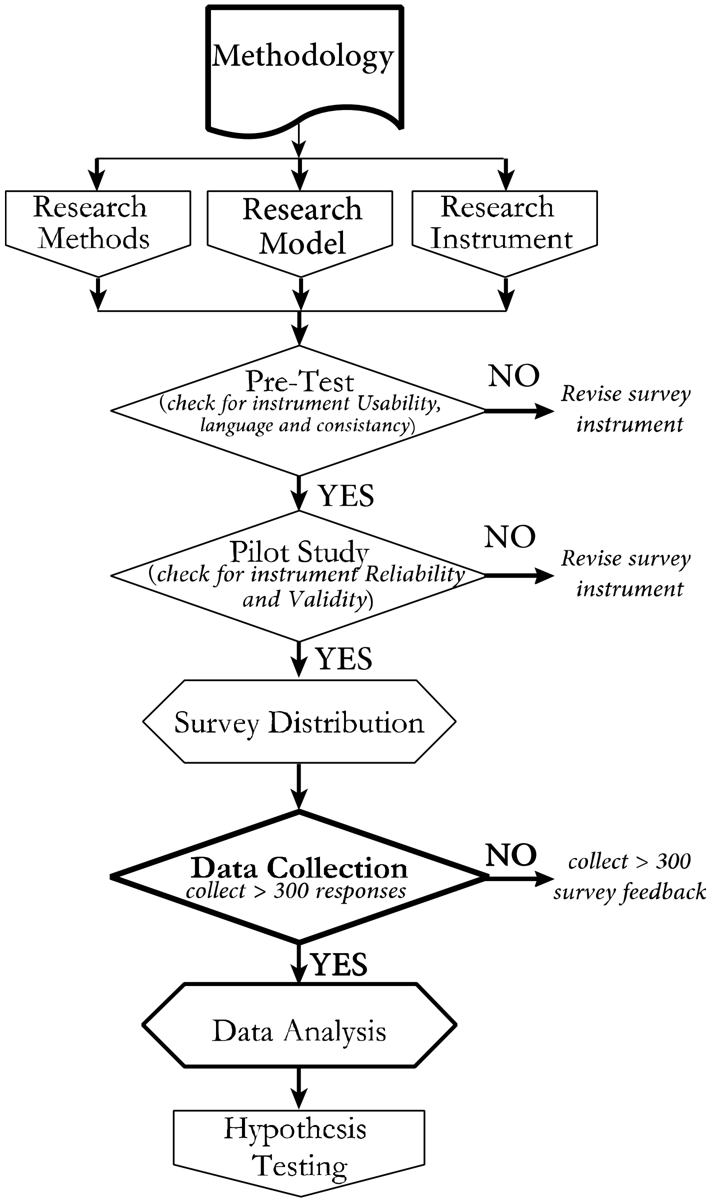

Figure 17: Thesis Research Methodology Flowchart

The selection of research method and instrument was followed by instrument testing as Pre-Pilot and Pilot studies. The results from the Pilot study shaped the main study data collection.

4.2 Research Design

The nature of this research is comparative descriptive design which is based on comparing two or more groups of participants or entities (Ross, 2005). Quantitative research methods are best suited to investigate attitudes, determine factors and explore relationships between factors or different groups (Gogolin & Swartz, 1992). A thorough literature review on technology acceptance was conducted in order to establish relevant parameters, variables and moderators which could better define the acceptance of Smartphones as learning tools. As noted, this thesis compares the acceptance of Smartphones in the two different contexts (The College of Engineering - CX1 and The College of Education - CX2).

The survey used in this research was divided into four sections. The first section (Part - A) collected information regarding the characteristics of the respondents; for example, age, gender, college, educational level and Smartphone ownership. The second section (Part - B) of the survey asked about the students' willingness to use Smartphones for learning activities, such as reading eBooks, watching video lectures, listening to podcast, taking quizzes and accessing learning resources. The third section (Part - C) concentrated on finding out about the frequency of use of Smartphones for education (for example, accessing learning content, eBooks and distributing educational content). Part - D dealt with measuring items from the UTAUT2 constructs. The total number of items in the questionnaire for each section were: Part-A=11, Part-B=14, Part-C=10 and Part-D=62.

4.3 Type of Research

Descriptions of the research methodology adopted by this thesis include explanations of the research context, information about the sample population, sampling methods, sample sizes, research techniques and demographic information regarding the research questions. The hypothesis chapter contains the detailed descriptions of the hypotheses formulations of this research. This thesis uses a confirmatory quantitative method in which the results are confirmed using the support from the hypothesis.

4.3.1 Quantitative Research

As stated earlier, this study uses a quantitative correlation research methodology to construct a quantitative research design based on an established scientific method. This technique employs deductive reasoning by formulating a research hypothesis at an early stage.

The quantitative research in this study was initially pursued by gathering facts and statistical parameters, which were used to study the relationship of one set of facts to another as suggested by Fan, Sivo, and Keenan (2002). According to Hopkins, Marshall, Batterham, and Hanin (2009), quantifying the relationships between dependent and independent variables expresses those relationships after using statistical techniques. The research methodology employed in this research was an inferential form of logic, whereas, theories and hypotheses are tested in a cause-and-effect order using multivariate regression techniques (Creswell, 2013).

Data was collected and statistical results are analysed to confirm support for the hypotheses. A quantitative research design used cross-sectional survey data after gathering all the survey responses at a single point in time (Hopkins et al., 2009). The collected quantitative data of multiple variables will be analysed using multivariate statistical technique using Structural Equation Modeling (SEM) (Khine, 2013). This thesis conducted meta-analysis of the literature review in order to identify an appropriate research model and determine the research’s parameters, as well as statistical testing techniques and sample size.

4.3.2 Meta-Analysis

To better assess the required survey instrument, test and instrument usability, validity and reliability for this thesis, a comprehensive meta-analysis was conducted. Appendix B illustrates scale evaluation techniques in the field of educational technology integration, technology acceptance and information systems research.

The Meta-analysis statistical method used in this research combines data from multiple studies in similar areas of research (Crombie & Davies). Adopting this technique helped this research to identify common research methods and design, as well as to identify the required descriptive and inferential statistics shared by the selection of studies under review (Wolf, 1986). Conducting meta-analysis in the area of research before carrying out the main study helps researchers to be more precise and reliable with high volume literature reviews (King & He, 2006). Many researchers believe that meta-analyses are more reliable than literature reviews, as they are less susceptible to judgmental and subjective errors (King & He, 2006). However, researchers using meta-analyses need to be careful of sampling bias when selecting the research literature data (King & He, 2005, 2006).

The meta-analysis of this research was consolidated by collecting publications from the field of technology acceptance using the UTAUT and UTAUT2 models. The literature review focused on the most recent data, limiting it to the previous three years in order to ensure that it was relevant and current. A total of 51 published journals and conference proceedings were selected. Out of the 51 research publications studied, 29 reported conducting internal confirmatory factor analysis (CFA), 27 of them reported conducting convergent validity and 22 of them conducted discriminant validity tests as part of construct validation. A total of 10 research studies conducted content validity using Pilot studies. A couple of studies also used test-retest methods as part of their research. It is evident that internal consistency tests (Cronbach-Alpha) and construct validity tests were conducted as part of the survey instrument evaluation.

This research conducted scale evaluation and instrumentation validation to strengthen the research methodology and allows other researchers to reuse the pretested instruments in similar or heterogeneous environments. A thoroughly validated instrument can measure similar research parameters, assuring improved and dependable results from a priory model (Straub, 1989). Scale evaluated research also helps researchers to formulate and interpret results and analysis more clearly and confidently.

4.4 Research Model

This thesis aims to determine whether there is a place for Smartphones as educational tool within a university context. To that end, the UTAUT2 model will be used to assess the behavioural intention of using technology. As explained earlier, this thesis theorises that the moderators (context, gender and educational level) will, along with the seven UTUAT2 constructs, significantly affect the behaviour intention to use Smartphones for education. This chapter provides a detailed overview of the methods used in this thesis. The eight constructs of the UTAUT2 model are as described below:

1. **Performance Expectancy (PE):** the degree to which using a particular technology will improve performance
2. **Effort Expectancy (EE):** the degree of ease associated with the use of that technology
3. **Social Influence (SI):** the extent to which the user perceives that he should use said technology
4. **Facilitating Conditions (FC):** the resources and support available to use the technology
5. **Hedonic Motivation (HM):** the pleasure derived from using the technology
6. **Price (PR):** the cognitive trade-off between perceived benefits of using technology and the costs of using it
7. **Habit (HA):** the extent to which the user believes the use of said technology is instinctive or habitual

4.5 Moderators

Although the three moderators have been discussed in detail in the Hypothesis Chapter of this thesis , a brief discussion is provided as follows

1. **Context :** The population sample of this study
    a. **The College of Engineering (CX1)**
    b. **The College of Education (CX2)**
2. **Gender**
    a. **Men (M)**
    b. **Women (W)**
3. **Level of Education:** the two main stages of University Education
    a. **Undergraduate Level (UG):** The basic undergraduate enrolment
    b. **Postgraduate Level (PG):** This level comprises of students who enrol in either a Masters or a PhD degree programme at the University.

4.6 Ethical Considerations

Every research aims to adhere to a strict code of conduct, hold to some core principles and finally aims to contribute to the body of knowledge (Resnik, 2011). Sammons (1989) describes research ethics as a researchers commitment to conducting the research honestly to respect a participants privacy and, dignity and to truthfully observe human values and ethics. According to Resnik (2011), ethical considerations aid researchers to distinguish between acceptable and unacceptable behaviour.

Educational institutes follow strict ethical standards that aim to help the researchers, academic societies and students, conduct and coordinate their research or activities in ways that both establish and respect public opinion. They also aim to promote the values that are essential to collaborative work, accountability, respect and fairness. This research took all these aspects and criteria into strict consideration and developed the research methodology,. Special care was taken to keep all information given by the participants strictly and confidentially in order to guard their privacy. A cover letter was included which explained the purpose of the research to the respondents before conducting the survey. This letter was designed so as not to violate the self-esteem or self-respect of the participants and that no one would be feel forced to respond to the survey and it was made clear that all aspects of the survey is were voluntarilily. Finally, it was also mentioned that all the aspects of the survey responses would be logged without the registration of the respondent's identity, and that all the data would be kept strictly confidential.

The survey respondents were also reminded regarding their ethical behaviour that once they volunteer to take part in this research they should cooperate fully with obligations to be honest in their responses. A proposal for this thesis was submitted to the Educational Research Ethics Committee (ERHEC) for approval to conduct surveys with human subjects. It included information about the instrument to be used, the population sample, the nature of this project, its purpose, focus and methodology. A detailed cover letter explained the mechanisms in place to preserve the respondents' anonymity and what the survey would include.

4.7 Sample Size

This assessment of the sample size depends on two criteria: the ratio of the number of variables to the number of factors; and the number of the factors to be extracted. In general, over 300 cases are considered adequate for analysis (Field, 2013). The sample size can seriously influence the reliability of the extracted factors. Factor analysis is a technique that requires a large sample size. Tabachnick and Fidell (2001) and Caprara, Barbaranelli, and Comrey (1995) advise that 50 cases are a very poor sample size, 100 are considered poor, 200 cases is considered fair, while 300 cases is the best.

(Fan, Thompson, & Wang, 1999) consider a sample size of 200 to be adequate. Meta-analysis of literature review, revealed that most of the studies conducted in the technology acceptance field had collected data in the range of 200-300 samples (see Figure 15.0).

After considering the previous research, the number of sample subjects was set at 300 (Alrawashdeh et al., 2012; Chen et al., 2009; Leong, Hew, Tan, & Ooi, 2013; Luan & Timothy, 2008; Pitchayadejanant, 2011; Raman & Don, 2013; Shin et al., 2011; Wang et al., 2009; Wilson, Mao, & Lankton, 2010). A good sample size tends to minimize the probability of errors, maximize the accuracy of population estimates and increase the generalisability of the results. A good sample size also achieves a better "goodness of fit" for the data.

4.8 Data Collection Methods

This research employed the opportunity sampling technique, which is also known as convenience sampling (Joy, 2007). Convenience sampling allows a researcher to choose the nearest individuals to serve as respondents and to continue to execute this process until the required sample size is achieved by the research in the available and accessible time. (Weir & Jones, 2008). Researchers often choose the sample from those whom they have easy access to, and thus, the main advantage of convenience sampling is the ease with which it can be carried out. The other advantage in using the convenience sampling technique is that the data is collected in a short span of time without the need of conducting exhaustive research on the entire population (Marshall, 1996). In order to ensure that the data collected for this thesis was free from bias, influence or under-representation, the following precautions were observed:

1. Data collection was done by visiting all of the department classrooms of both the contexts of the study equally (The College of Engineering: CX1 and The College of Education: CX2)
2. Data was also collected by placing a kiosk in the student library for students who volunteered to take the survey
3. An online version of the survey was developed on the university polling application "Qualtrix." The online link was distributed to students who visited the library and the student café.
4. A seminar and personal visits were also conducted to the faculty in order to introduce the scope and importance of this research. This helped in reaching the maximum number of faculty support for survey administration

The total number of students enrolled in the university at the time of the survey equalled 14,725, of which 11,943 were full time students. A further breakdown of the students enrolled in the university showed that 9,721 were undergraduates (81%), while 2,222 were enrolled as postgraduates (19%). The participants in this study come from two colleges of the University of Canterbury - the College of Education [1,852 respondents (16%)] and the

College of Engineering [2,849 respondents (24%)]. Their enrolment took place during the 2014 academic year.

During the process of instrument development and testing, the emphasis was on the proper instrument design for the statistical analysis methods to be used. This study distributed a total of 1170 questionnaires and received 311 responses. Approximately 99% of the questionnaire was answered on paper, and 1% was answered online.

A cover letter informed and instructed students about the scope of the survey. A total of 12 questionnaires were invalidated due to incomplete submissions. A detailed description of the data sample and descriptive information is illustrated in Table 1. The frequency column summarises the total number of cases. Another column displays this frequency in percentage form for all cases.

Final Study Instrumentation: Student responses were based on the Likert scale, as explained earlier. These items were adapted from various published sources (Luan & Timothy, 2008; Pahnila et al., 2011; Pheeraphuttharangkoon et al., 2014; Venkatesh et al., 2012; Wilson et al., 2010; Yu, 2012). Five-point Likert Scales ranging from “strongly disagree” to “strongly agree” were employed for responses to all these items. In accordance with the usual methods, the reliability, validity, covariance and model fit indices were analysed.

4.9 Scale Evaluation

Research is susceptible to human errors such as bias and inadequate research methods which can subsequently lead to irrelevant results (Worthington & Whittaker, 2006). This study placed importance on the fact that no matter how well the research is conducted, it still carries the potential to be inaccurate (Carmines & Zeller, 1979, p. 11). Hence it used scale measurement and instrument validation aimed at lessening the possibilities of inaccuracy.

The process of scale measurement followed in this study started by developing, testing, and using the survey instrument in order to avoid errors. Testing criteria, include usability, reliability and validity (Finstad, 2006). This research tested the usability to identify how easily the survey instrument was understood by the participant; it also tested the reliability of the instrument to assess the stability of its measures (Carmines & Zeller, 1979). Wenger and Spyridakis (1989) posit that usability, validity and reliability are three important characteristics required to substantiate any research work, each consisting of a number of elements also outlined in the Figure 18. The next section talks about those in turn.

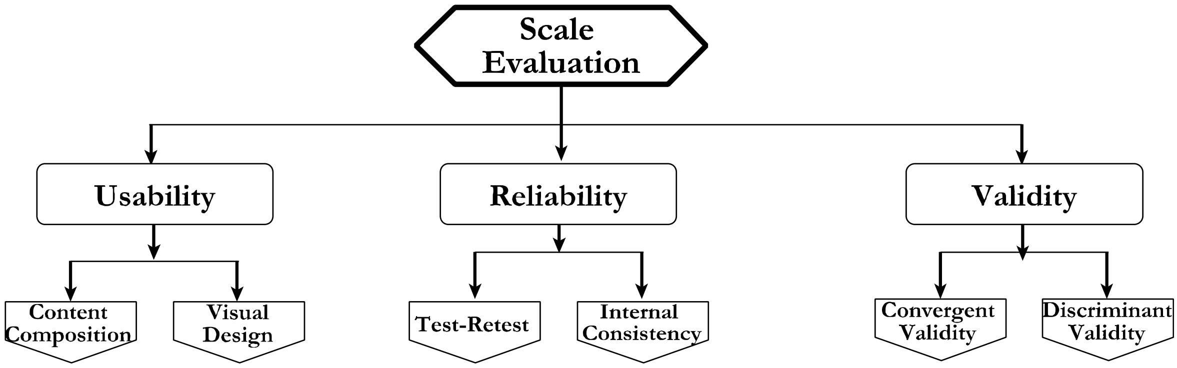

Figure 18: Type of Instrument Scale Evaluation

4.9.1 Usability

At the outset this research assessed the usability of the content composition of the survey questionnaire. This assessment included the layout of the textual content, which should be legible, interesting and visually appealing. Barnum and Dragga (2001) describe usability as making systems easier to use, and are closer to user needs and requirements of the user. The basic elements of usability which create visual designs include: the selection of typography, form, the unification of the text content hierarchy, and maintaining a balance between dull and overwhelming designs (Fanning, 2005).

This thesis incorporated document formatting, content layout and visual design as suggested by the literature review (Smyth, Dillman, Christian, & Stern, 2006). The content was designed to be as readable as possible, so that the respondent was able to follow it easily. Line dividers were used to separate information and checkboxes were used for obtaining answers. Care was taken to avoid lengthy questions that could exceed two lines. All of the sections of the questionnaire had simple and concise headings. The spacing between characters, words, lines and paragraphs were kept within the visual design standards which enhanced their legibility.

4.9.2 Reliability

One of the main concerns of this study was to assess the reliability of the instrument and to test its ability to measure a construct consistently for what it is intended to measure (Hayes, Walton, Szomor, & Murrell, 2001). This research followed Hayes et al. (2001)'s recommendations to assess the Internal Consistency Reliability.

Cronbach's alpha is the most common assessment performed to assess internal consistency (Santos, 1999). This test measures how well a survey addresses different constructs and provides reliable scores, by measuring two different versions of the same item within the same test. Cronbach's alpha test gives a score of between "0.00" and "1.00.", A score of 0.7 is generally accepted as a sign of reliability (Hair, Black, Babin, Anderson, & Tatham, 2006). This acceptance level accommodates both the sample size and the number of available responses.

If the correlation is high, there is evidence that the questions are measuring the same underlying construct, therefore indicating a reliable scale (Hair et al., 2006). According to Tavakol and Dennick (2011), the alpha value should be at least 0.70 to achieve an "adequate" scale and 0.80 to achieve a "good" scale. A detailed discussion of the internal consistency reliability and instrument Validity for the main study is conducted in the Principal Component Analysis (PCA) factor extraction stage of this thesis.

4.9.3 Instrument Validity (Construct Validity)

This research investigated instrument validity by conducting convergent validity and discriminant validity tests which are also termed as construct validity. These tests are discussed in the Results and Analysis chapter of this thesis due to their applicability associated with the results chapter.

4.10 Survey Instrument Design

As explained earlier, this study used surveys as the primary way of collecting empirical data. All of the UTAUT2 constructs and moderators were measured with multiple items. Each of these construct items was adapted as a result of an extensive review of technology acceptance literature (Luan & Timothy, 2008; Pahnila et al., 2011; Pheeraphuttharangkoon et al., 2014; Venkatesh et al., 2012; Wang et al., 2009; Wilson et al., 2010; Yu, 2012). The questionnaire content was modified to suit the research requirements and the context of the thesis.

The Social Influence construct was redefined to suit the background of this study by replacing the original items which focused on the influence of family and friends to a purely academic social influence. This redefinition concentrated on the influence of classmates, peers and teaching staff in accepting the Smartphone as a learning tool. Similarly, the Facilitating Conditions construct was redefined from the original item (which focused on technical support and technology reliability) to creating an environment which fosters the use of smartphones to get educational support from peers and friends.

The survey instrument adapted in this thesis had been used by numerous studies and was proven to be valid and reliable (Alrawashdeh et al., 2012; Pahnila et al., 2011; Raman & Don, 2013; Venkatesh et al., 2012; Wang et al., 2009; Yang, 2013; Yu, 2012). The questionnaire was developed on the basis of the UTAUT2 model (Venkatesh et al., 2012) which was modified as a result of Pre-Pilots and Pilot results .

4.11 Pre-Pilot: Preliminary Survey Instrument Testing

The assessment of content reliability for the survey instrument was performed using a two-step process. A Pre-Pilot was conducted which incorporated the views of four faculty members and 16 students from both contexts. This two-step instrument testing technique provided good feedback relating to the administration of the instrument, data collection methods, testing the instrument's reliability and validity and data logging techniques. It also provided a basic understanding of the statistical software which would be used for data analysis.

Most of the students consulted for the Pre-Pilot were directly involved in conducting survey based research and instrument development. This Pre-Pilot was anonymous and was divided into two parts Pre-Pilot-I and Pre-Pilot-II:

4.11.1 Pre-Pilot-I

The Pre-Pilot-I survey was divided into four parts (Appendix C) for further information. The following section describes all the four parts (A, B, C and D) of the survey in succession.

Part A:

This part dealt with acquiring participants' demographic data, including their gender, age, university enrolment level and, current year of study. It also collected information about their Smartphone ownership, Smartphone make, duration of Smartphone use in years, Smartphone operating system, Smartphone expertise and awareness of online learning resources. There were 11 questions in this part of the questionnaire. The response scale for this section of the questions was subjective. This section will provide the data relating to the moderators of the study and will also aid in generating descriptive statistics.

Part B:

The questions in Part - B investigated student perception on their use of Smartphone applications for their regular academic activities including reading eBooks, recording lectures in video/audio forms, taking assessments and collaborating online for learning. A total of 14 questions were included in this part of the survey. In order to gain more insight, the queries in this part were designed to directly question and isolate student opinion regarding the use of Smartphones for education. These questions were derived after an extensive literature review. The response scale for this part was a Likert scale of "strongly agree" (1), "agree" (2), "disagree" (3) "strongly disagree" (4) and the "neutral" (0). This part of the survey was aimed at understanding the students opinion on using Smartphones for various academic activities like reading eBooks, taking online quizzes and, submitting assignments. The responses obtained showed this research the studetns willingness to use Smartphones for such activities.

Part C:

This part of the questionnaire was designed to discover the current frequency of use of Smartphones by the sample population. The literature review found evidence of Smartphone ubiquity, especially among the younger generation. It posited the substantial use of Smartphones for many daily activities such as, communication, entertainment, information searches, photography, personal assistance (reminders, alarms and personal diaries) and navigation. This section of the survey assessed the frequency of using Smartphone for various common activities such as checking email, listening to music, checking email, playing games etc. The data provided confirmed the widespread use of Smartphone by the sample population of this study. The feedback scale for this part of the survey questionnaire was also based on the Likert Scale ranging from "very often" (1), "often" (2), "sometimes" (3) "rarely" (4) and the "never" (0).

Part D:

Part - D was the main questionnaire of this study, based on the UTAUT2 model. It enquired into all the seven constructs by using 68 questions. All the items of the survey were measured with a five-point revised Likert scale. The Likert scale for the main study was revised after discovering that 40% of the respondents preferred to choose neutrality as their response during the Pre-Pilot and Pilot survey. The Likert scale of the survey instrument was reorganised by assigning "strongly agree" (1), "agree" (2), "disagree" (3) "strongly disagree" (4) and "neutral" (0). Bishop (1987) posits that respondents prefer selecting the middle response (i.e., the neutral response) when given the option in the questionnaire. Schuman and Presser (1981) have conducted experimental research in relocating the middle response of the Likert scale, or omitting it. The Pre-Pilot respondents were asked about the clarity, wording and format of the instrument. After the Pre-Pilot, a Pilot-test was conducted to further validate both the reliability and validity of the instrument.

4.11.2 Pre-Pilot-II: Feedback

The second part of the Pre-Pilot survey was the assessment of feedback over the clarity of the questions from each section, the sentence phrasing, the terminology used, the motivational level to answer the survey, the understanding of Smartphone features and redundant questions in the survey. Respondents were asked to answer them in a 'yes', 'no' and 'can't say' format as shown in Table 24. To improve the survey, the respondents were encouraged to underline errors, write suggestions or comments on the following topics; content language, content comprehension, language, grammar, survey time, content comprehension and the consistency of the questionnaire. It was assumed that such feedback would be very valuable in making the instrument more accurate and consistent and subsequently develop a successful questionnaire.

Table 24: Pre-Pilot Respondents' Feedback

No	Pre-Pilot Survey Feedback	Yes	No	Can't Say	Frequency
1	Were the items in Part - A clear in meaning?	94%	0%	6%	16
2	Were the items in Part - B clear in meaning?	44%	6%	50%	16
3	Were the items in Part - C clear in meaning?	75%	0%	25	16
4	Were the items in Part - D clear in meaning?	56%	38%	0	16
5	Kindly underline the words or statements which were not clear to understand				
6	Were the questionnaire scale appropriate for rating?	88%	0%	0	16
7	Was the questionnaire targeted to academic education?	88%	6%	6%	16
8	Do you understand the difference uses of a Smartphone	94%	0%	6%	16
9	Do you think the language of the survey was well articulated?	75%	13%	13%	16
10	Was the questionnaire time consuming to answer?	13%	81%	6%	16
11	Did the questionnaire interest you?	88%	6%	6%	16
12	Were the questions repetitive?	50%	38%	13%	16

Consequent improvements were conducted on the survey to improve the clarity of the text meaning or for the selection of better words as suggested by the respondents. After reviewing the feedback from the Pre-Pilot respondents, the survey's content, language, wording, technical terminology and a number of redundant questions were modified. Care was also taken to compose the survey layout, font type and size to make it graphically pleasing to read and answer, as explained in the usability aspect of this chapter. After the detailed revision from the Pre-Pilot response, the survey instrument was then tested in the Pilot study.

4.12 Pilot Study: Instrument Testing

To further confirm both the reliability and validity of the instrument, a Pilot study was also conducted. van Teijlingen and Hundley (2001) suggest that Pilot studies provide good information as a preparation for the major study to test the instrument's validity and reliability. Denise, Beck, and Hungler (2001) recommend that the Pilot study should identify potential cautionary areas where the survey could fail.

The Pilot sample for this research comprised of a smaller number of participants with characteristics similar to those of the target group of respondents (Carmines & Zeller, 1979; Denise et al., 2001; Hair Jr, Hult, Ringle, & Sarstedt, 2013). Further, the Pilot study was conducted in both contexts (CX1 and CX2) separately in order to better understand the feedback of both the contexts. It was expected that this would not only represent the sample configuration of the main study, but it would also provide insight into how the survey could be administered and distributed in the two contexts.

Section - A of the Pilot test contained questions concerning the demographic data of the respondents. Questions in Section - B centred on the student's preferences when using Smartphones for common academic activities. Section - C was designed to assess the current use of Smartphones for common activities by the students. Section - D, the last part of the survey instrument, had the main questionnaire items of this research, which comprised of an initial 65 questions for the Pilot and were later increased to 68 questions. As noted earlier, the design of the survey instrument of this research was based on the earlier validated and tested UTAUT2 model (Venkatesh et al., 2012).

4.13 Pilot Study: Descriptive Statistics

The main objectives of the Pilot study were to improve the content validity of the preliminary version of the survey, as well as to understand the administration and feedback gathering methods. Content validity is the assessment of how much an empirical measurement reflects a specific area of content (Carmines & Zeller, 1979, p. 20). The assessment of the initial version of the survey instrument for face and content validity was performed by analysing Pilot data with Pearson's correlation.

As explained earlier, the UTAUT2 model measures eight constructs to assess student's behavioural intention to use Smartphones as learning tools. Similar to the survey instrument used in the Pre-Pilot, the Pilot study also incorporated all of the survey items by structuring them into four parts (A, B, C and D). Part - A of the questionnaire comprised of demographic questions; Part - B question students' opinions on using Smartphones for education, and Part - C examined the frequency of the current use of Smartphones. Lastly, Part - D was the main questionnaire of this study which was based on the UTAUT2 model and was designed to investigate the seven constructs via 68 questions. All of the items of the survey were measured with a five-point Likert scale, ranging from "strongly agree" (1), "agree" (2), "neutral" (3), "disagree" (4) and "strongly disagree" (5).

4.13.1 Pilot Study: Part - A Results

Of the 30 subjects surveyed, two were Men and 13 were Women for CX1; while 11 females and four males formed CX2. Between both contexts of the study, more than 85% of the students were found to be using Smartphones, and more than 60% of the users rated themselves as *expert* to *good* users of Smartphones. 33% of CX1 students used Apple iPhones and 60% of them used Android. In CX2 33% of the students used Android Smartphones and 40% used Apple iPhones. 50% of the students seems to be well aware of online content for learning as illustrated in Table 25.

Table 25: Pilot Study Questionnaire Part A: Descriptive Statistics

	Section A Questions	CX1		CX2	
1	**Gender**	%	Frequency	%	Frequency
	Female	13%	2	73%	11
	Male	87%	13	27%	4
2	**Age (years)**				
	Below 18	0%	0	0%	0
	18-20	7%	1	13%	2
	21-25	20%	3	13%	2
	26-30	40%	6	20%	23
	31-40	27%	4	47%	7
	Over 40	7%	1	7%	1
4	**Program**				
	Undergraduate	20%	3	20%	3
	Postgraduate	27%	4	53%	8
	PhD	53%	8	27%	4
5	**Year of Study**				
	First	47%	7	33%	5
	Second	20%	3	27%	4
	Third	7%	1	33%	5
	Fourth	20%	3	0%	0
6	**Device Ownership**				
	Smartphone	80%	12	67%	10
	Tablet	0%	0	0%	0
	Both	13%	2	13%	3
	None	7%	1	20%	2
7	**Operating System**				
	Android	60%	9	33%	5
	Apple iOS	33%	5	40%	6
	WinOS	0%	0	7%	1
	Others	7%	1	13%	2
8	**Skill level**				
	Expert User	20%	3	0%	0
	Good User	60%	9	60%	9
	Limited user	20%	3	33%	5
9	**Choice Device**		0		
	Smartphone	20%	3	40%	6
	Tablet	20%	3	7%	1
	Both	27%	4	7%	1
	None	33%	5	27%	4
10	**Online Content Awarenes**				
1	Open Courseware (OCW)	0%	0	0%	
2	Open Education Resources (OER)	0%	0	20%	3
3	MIT Open Education Resources	27%	4	13%	2
4	Khan Academy	7%	1	13%	2
5	Coursera	0%	0	0%	0
6	Massive Open Online Courses (MOOCs)	7%	1	7%	1
7	Udacity	0%	0	0%	0
8	None	53%	8	40%	6

4.13.2 Pilot Study: Part - B Results

Part B results of the Pilot revealed that an average of 62% (CX1) - 65% (CX2) of the students agreed to using Smartphones for learning activities. Part – B questions centred around using Smartphone applications for learning, reading eBooks, video lectures, taking assessments and collaborating online for leaning, as illustrated in Table 26.

Table 26: Part – B: Students' Readiness to use Smartphone

PART-B	Questions	Context	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q1	Mobile apps (applications) for learning	**CX1**	27%	53%	20%	0%	0%
		CX2	27%	33%	33%	7%	0%
Q2	Taking notes during lectures	**CX1**	7%	33%	33%	27%	0%
		CX2	27%	20%	40%	7%	7%
Q3	Reading eBooks	**CX1**	27%	47%	20%	7%	0%
		CX2	20%	53%	7%	20%	0%
Q4	Using online resources	**CX1**	20%	60%	20%	0%	0%
		CX2	33%	47%	13%	7%	0%
Q5	Searching for educational resources	**CX1**	40%	60%	0%	0%	0%
		CX2	40%	40%	7%	13%	0%
Q6	Viewing Video or Audio recorded lectures	**CX1**	27%	67%	7%	0%	0%
		CX2	20%	40%	20%	13%	0%
Q7	laboratory experiments and Data logging	**CX1**	7%	20%	47%	27%	0%
		CX2	13%	13%	53%	13%	7%
Q8	Taking Assessments, quiz, surveys and polling	**CX1**	13%	40%	20%	20%	7%
		CX2	27%	33%	27%	13%	0%
Q9	Submitting assignments	**CX1**	7%	13%	47%	27%	7%
		CX2	20%	27%	33%	13%	7%
Q10	Asking questions to the lecturer	**CX1**	7%	33%	20%	33%	7%
		CX2	27%	40%	20%	13%	0%
Q11	Communicating with friends for educational help	**CX1**	40%	27%	27%	7%	0%
		CX2	40%	33%	13%	7%	7%
Q12	Using Social Networking for learning	**CX1**	20%	53%	20%	7%	0%
		CX2	20%	47%	27%	7%	0%
	Collaborating online for learning	**CX1**	27%	47%	20%	7%	0%
		CX2	13%	60%	20%	7%	0%
Q14	Collaborating with faculty for educational help	**CX1**	27%	27%	33%	13%	0%
		CX2	20%	60%	13%	7%	0%

An average of 27% of CX1 and 13% of CX2 students did not prefer to use Smartphones for data logging, laboratory work or for submitting assignments. Students were undecided when it came to using their Smartphones for taking notes during lectures (33%); 27% of CX1 students disagreed with this statement. CX2 students displayed a similar pattern of neutrality, with 40% remaining neutral while 13% disagreed. Of the 14 questions, 11 demonstrated a high inclination of using Smartphones for education.

4.13.3 Pilot Study: Part - C Results

This part of the survey questionnaire was interested in finding out about the current use of Smartphones by the students from the two contexts of the study (CX1 and CX2). Students displayed an active use of Smartphones for the following activities: checking emails (40% in both CX1 and CX2), accessing educational content (87% in CX1 and 47% in CX2), playing games (67% in CX1 and 20% in CX2) and social networking (33% in CX1 and 40% in CX2). A lesser use of Smartphones was displayed for distributing files (60% in CX1 and 67% in CX2) and listening to music (60% in CX1 and 53% in CX2) as shown in Table 27.

The feedback displayed a few anomalies, at the same the students showed marked differences in their opinions: 67% of CX1 students used Smartphones for playing games while 53% of CX2 students didn't. The same pattern was repeated for watching movies with 53% of CX1 students using Smartphones for the same while 47% of CX2 students didn't. Student feedback result showed that students currently did not use Smartphones for reading eBooks (60% in CX1 and 40% in CX2), online banking (47% in CX1 and 40% in CX2) or online shopping (67% in CX1 and 33% in CX2).

Table 27: Part – C: Assessing Current use of Smartphone for Education

PART-C	Questions	Context	Very Often	Often	Sometimes	Rarely	Never
Q1	Checking emails	**CX1***	13%	20%	7%	20%	40%
		CX2	33%	7%	7%	33%	20%
Q2	Reading eBooks	**CX1***	13%	20%	7%	0%	60%
		CX2	7%	27%	7%	20%	40%
Q3	Distributing Files	**CX1***	7%	13%	33%	27%	20%
		CX2	0%	7%	40%	27%	27%
Q4	Accessing Educational Content	**CX1**	40%	47%	0%	0%	13%
		CX2*	40%	7%	13%	20%	20%
Q5	Playing Games	**CX1***	33%	33%	0%	7%	27%
		CX2	0%	20%	27%	27%	27%
Q6	Listening to Music	**CX1**	0%	20%	40%	20%	20%
		CX2*	13%	13%	13%	40%	20%
Q7	Watching Movies	**CX1**	20%	33%	7%	0%	40%
		CX2*	20%	13%	13%	33%	20%
Q8	Social Network (Facebook, Twitter etc.)	**CX1**	7%	27%	27%	7%	33%
		CX2*	33%	13%	13%	27%	13%
Q9	Online Banking	**CX1**	0%	7%	27%	20%	47%
		CX2*	20%	0%	13%	27%	40%
Q10	Online Shopping	**CX1**	0%	7%	27%	0%	67%
		CX2*	7%	7%	20%	33%	33%

4.13.4 Pilot Study: Part - D Results

This thesis examined the correlation between each question's scores with the dependent variable (behaviour intention). Statistical analysis was performed using Microsoft Excel 2010. The demographic data and scores were expressed in the form of percentage. Cronbach's α was used to evaluate internal consistency; the correlations among preliminary data were measured using Pearson's correlation. In this study, Pearson's correlation was defined as follows: $r < 0.3$, weak; $0.3 < r < 0.7$, moderate; $r > 0.7$, strong (Hair et al., 2006). P values of less than 0.05 were deemed to be statistically significant.

The correlation coefficients that form Part D of the questionnaire were examined individually for both contexts, using Microsoft Excel 2010. The quantity r, which is the linear correlation coefficient, measures the strength and the direction of a linear relationship between two variables. Table 28 illustrates the relationship with the dependent variable behaviour intention (BI) against which all of the seven constructs of the UTAUT2 technology acceptance model were tested. The linear correlation coefficient is also referred to as the "*Pearson product moment correlation coefficient*" and is denoted by the letter *r*. To interpret the proportion of the variance of the dependent variable from the independent variable, the coefficient of determination is used. The coefficient of determination, r^2 gives the proportion of the variance (fluctuation) of one variable that is predictable from the other variable and this is the square of the correlation (r). It is computed as a value between 0 (0 %) and 1 (100 %). All the predictor variables of the UTAUT2 constructs in CX1 showed strong correlations with the dependent variable behaviour intention. This is indicative that the seven constructs are predictor variables.

The dominant correlation coefficients of the UTAUT2 model constructs on behaviour intention in CX1 are performance expectancy (0.929), hedonic motivation (0.876), social influence (0.855) and facilitating conditions (0.719). The correlation coefficient for effort expectancy (0.387) was low. Those for price (-0.039) and habit (-0.006) showed inverse effects. The dominant determinant coefficients for CX1 on BI were performance expectancy (86%), hedonic motivation (77%) and social influence (73%). The determinant coefficient for effort expectancy (15%) was low. Price and habit did not show any correlation. The dominant correlation coefficients of the UTAUT2 model constructs in CX2 were hedonic motivation (0.847), performance expectancy (0.839), social influence (0.839), facilitating conditions (0.832) and effort expectancy (0.718). The correlation coefficients for habit (0.582) and price (0.342) were low. The dominant determinant coefficients for CX2 were hedonic motivation (71%), performance expectancy (70%), social influence (70%), facilitating conditions (69%) and effort expectancy (51%). The determinant coefficients for habit (34%) and price (11%) were low as shown in Table 28.

Table 28: Part-D, Correlation Coefficients of UTAUT2 variables

Correlation Coefficients					Reliability Statistics	
Constructs	CX1		CX2		Cronbachs-Alpha	
	r	r^2	r	r^2	**Performance Expectancy (PE)**	0.879
BI-PE	0.929	0.863	0.839	0.704	**Effort Expectancy (EE)**	0.717
BI-EE	0.387	0.149	0.718	0.515	**Social Influence (SI)**	0.784
BI-SI	0.855	0.731	0.839	0.704	**Facilitating Conditions (FC)**	0.712
BI-FC	0.719	0.517	0.832	0.692	**Hedonic Motivation (HM)**	0.886
BI-HM	0.876	0.768	0.847	0.718	**Price (PR)**	0.879
BI-PR	-0.039	0.001	0.342	0.117	**Habit (HA)**	0.762
BI-HA	-0.006	0.000	0.582	0.339	**Behaviour Intention (BI)**	0.892

The comparative assessment of the determinant coefficients between the two contexts reveals that performance expectancy, social influence, facilitating conditions and hedonic motivations had almost similar effects in both the contexts. Effort expectancy, price and habit had different correlation coefficients between the two contexts. Similarly, price and habit showed negative influence in CX1 while exhibiting positive correlation coefficients in CX2.

The main idea behind the comparison of the two contexts of this study was to prove the hypothesis that the BI to accept Smartphones as learning tools would vary across different contexts. This was clearly reflected in the Pilot study results as shown in Table 4. However, the sample size for the Pilot study was small. The effects referred to previously would be better reflected in the main sample.

The internal consistency reliability of the Pilot data was also assessed to ensure that all the items measuring the different constructs would deliver consistent scores. Table 14 illustrates the Cronbachs-Alpha values for all of the UTAUT2 constructs. All of the values obtained were above 0.7. According to Hair et al. (2006), any Cronbachs-Alpha values above 0.7 are considered excellent and Cronbach's alpha is a measure of internal consistency, which describes how closely related a set of data are as a group. To conclude, the required levels of instrument reliability were established.

4.14 Summary of Pre-Pilot and Pilot Study Observations

The instrument, survey distribution, data collection and analytical techniques were all designed by incorporating the observations, analytical results, participant feedback from the Pre-Pilot as well as the Pilot study. To get the best feedback, thirteen participants were involved in the Pre-Pilot (four professors and 16 PhD research students from the education disciplines).

The participants of the Pre-Pilot and the Pilot were asked to complete the questionnaire and write their comments on those items that they considered could have better alternatives. The participants were also requested to review the words of each item as well as comment on the time involved to complete the questionnaire (time that ideally should not exceed 12 to15 minutes). The Pre-Pilot feedback was used to design the instrument with appropriate, legible, easy to understand language and clear questions. Respondents were also consulted for their opinions in order to maximize the response. Many of the respondents from the Pilot study had emphasized a minimization of the number of pages in the questionnaire.

The Pilot study aided in structuring the demographic Part A and also the survey of part B and C. The main advantage of the Pilot was its contribution to the structuring of the text content of all the 64 items of the part D survey. Special care was taken from the Pre-Pilot feedback to position the Likert scale choices next to each question, thus facilitating the respondent's ease in ticking their response. The text layout was enhanced with a clear distribution of each question.

The results obtained from the Pilot study Pearson correlation revealed a strong positive correlation between all the items against the dependent variable showing strong evidence of theory proposed by this research. Internal consistency reliability was also measured to ensure that all the questionnaire items were measured consistently. The final version of the instrument was verified by identifying any confusing and ambiguous items, difficult vocabulary or complex sentence structures. Many items of the survey were rephrased for clarity after feedback was obtained from participants. A few items that were considered redundant, were removed. Section headings were also modified, after the recommendations from the pre and Pilot survey feedback.

The Pilot study helped this research in identifying the potential means and, locations for questionnaire distributed and also in identifying the faculty of the two colleges who could expedite a more homogenous, effective and unbiased distribution of the questionnaire. The validity of the questionnaire's content was tested during both the Pre-Pilot and the Pilot test. The faculty from the College of Education, who are involved in various areas of questionnaire development and sampling, were solicited in order to improve the quality of the questionnaire. Data gathering, entry, and storage and management techniques were all improvised following the lessons learned during the Pilot study. Field notes were documented and the filled survey responses were arranged and coded in a manner that made sense to the researcher. The Pilot data also helped in identifying the list of faculty members to be contacted. Their contact details were then organized in order to arrange for class visits where the survey could subsequently be distributed and administered. The experience from the Pilot study also helped in keeping the anonymity and, voluntariness of the respondents and in identifying any bias affecting the data collection procedure.

The Pilot study analytical results were conducted to test all of the items of the survey which were measured using the five-point Likert scale, ranging from “strongly agree” (1), “agree” (2), “neutral” (3), “disagree” (4) and “strongly disagree” (5). The Likert scale for the main study was changed after discovering that 40% of the respondents preferred to remain neutral in their response during the Pre-Pilot and Pilot surveys. The Likert scale of the survey instrument was reordered by assigning “strongly agree” (1), “agree” (2), “disagree” (3) and “strongly disagree” (4) and the “neutral” (0). This rearrangement of the scale was done to extract strong variance from the responses. This will subsequently aid in conducting efficacious factor analysis as well as building a robust structural equation model for hypothesis testing (Bishop, 1987; Nowlis, Kahn, & Dhar, 2002; Presser & Schuman, 1980).

4.15 Design of Main Study Survey

The final version of the questionnaire (see Appendix D) was divided into four sections after analysing the results from the Pre-Pilot and the Pilot study. The questionnaire's usability, validity and reliability were enhanced; whilst the few questions from parts A, B, and C which were found to be redundant, were removed or rephrased. Sixty-two out of 68 items in Part D were retained after the Pilot study results. Most of the items that were removed were with low Cronbach's Alpha, and a few were removed due to their redundancy. All of the items of the survey in Part - D were randomly placed. Special attention was paid to the usability and layout design principles to make sure the survey was interesting and graphically balanced. All of the elements of text and feedback tick boxes were placed in proximity and were aligned with each question. Enough space was added to create white spaces, around, above, below, or within the elements, creating positive and negative spaces that would be pleasing to the reader.

The instrument measurement was drawn from a solid theoretical foundation, while quantitative research was performed to select appropriate reliable measures required for this thesis. After conducting a detailed literature review of 43 research publications, the following reliability and validity tests were identified as key measurements.

4.16 Data Analysis Methodology

This research conducted both inferential and descriptive statistics. Ryon (2013) posits that all quantitative research analysing data collected through a survey instrument, conducts descriptive and inferential statistics analysis. Both descriptive and inferential statistics provide different insights into the nature of the data gathered and engaging with one alone cannot give the complete picture (Creswell, 2009). The following paragraphs explain the descriptive and inferential statistics drafted for this research:.

4.16.1 Descriptive Statistics

Descriptive statistics are statistical analyses that describe the gathered data. They are straightforward analyses which do not implicitly generalise beyond the collected data (Park, Nam, & Cha, 2012). The descriptive statistics used in this research was aimed to describe the basic features of the data and render simple summaries of the sample and the measures (Bless & Kathuria, 1993). IBM SPSS 22 software was used to conduct descriptive statistics, factor extractions. Descriptive statistics conducted for this research is given below:

1. Arithmetic Mean
2. Frequency and Percentage
3. Range and Standard Deviation
4. Skewness and Kurtosis

4.16.2 Inferential Statistics

Inferential statistics are often used to obtain conclusions after conducting data analysis, hypothesis testing, validating and reliability testing on the collected data (Babbie, 1992). With inferential statistics, the research tries to reach for conclusions that extend beyond the realm of descriptive statistics. The key benefit of inferential statistics lies in its ability to analyse and infer results from data which are based on random samples, taken from a population in order to deduce research hypotheseis (Babbie, 1992; Lowry, 2014).

This thesis used structural equation modelling after conducting intense meta-analysis. It was found that most researchers preferred to conduct multivariate structural equation modelling in the field of technology acceptance using the UTAUT2 model. The study involves understanding the covariance between multiple dependent and independent variables (Luan & Timothy, 2006, 2008; Pahnila et al., 2011; Raman & Don, 2013; Wang et al., 2009; Xu, 2014).

Multivariate data analysis involves taking appropriate steps and utilising the best practices to avoid subjective critical decisions (Williams, Brown, & Onsman, 2012). A detailed literature review in the domain of multivariate regression analysis revealed that a two-phase quantitative analysis would answer these challenges (Thompson & Daniel, 1996; Williams et al., 2012). The technique of multivariate regression analysis begins with conducting factor analysis, which is divided into two phases.

The first phase of this factor analysis is to conduct Principal Component Analysis (PCA), and the second phase Confirmatory Factor Analysis (CFA). PCA examines the data and its variables and extracts the best set of variables. IBM SPSS 22 software was used to conduct, factor extractions. Data after factor extraction was then made ready for the CFA phase. The second phase (CFA) checked the extracted set of variables against the model fit index, assessed the research validity and reliability, and in the end it verified the research hypothesis as suggested by (Beavers, Lounsbury, Richards, Huck, Skolits, & Esquivel, 2013). IBM AMOS 22 software application was used to conduct CFA, which involves developing measurement structural models Convergent validity and, discriminant validity were conducted to check the validity of the instrument. The following sequence describes both PCA and CFA which were further divided into four stages each for this research.

1. **Phase-I: PCA Factor Analysis**
    a. Stage-One: Check for data readiness
    b. Stage-Two: Assess adequate sample size and significance
    c. Stage-Three: Confirm initial factor extraction
    d. Stage-Four: Extract final set of factors
2. **Phase-II: CFA, Structure Equation Modelling (SEM)**
    a. Stage-One: Developing Measurement Model
    b. Stage-Two: Assess the Structure Model Validity
    c. Stage-Three: Develop Structure Model
    d. Stage-Four: Develop Path Models and Hypothesis Testing

There are numerous checks for data adequacy, significance and model fit before proceeding to the second part of SEM, as part of the confirmatory factor analysis (CFA) (Thompson & Daniel, 1996; Williams et al., 2012). Before proceeding to the CFA stage it is essential to assess whether the model fits the data well enough to reflect the reality of it.

Statistically, the model is evaluated by comparing two variance or covariance matrices. If the estimated variance/covariance matrix shows similarities with the known sample matrix, then the model is considered a good fit for the data (Im, Hong, & Kang, 2011; Park et al., 2012). In order to verify the fitness of the model for the data, a Chi-square statistic was used to test the null hypothesis (Huang, Wu, & Chen, 2012).

4.16.3 Phase-I: PCA (Factor Analysis)

The researcher assessed the seven constructs of the UTAUT2 model (Venkatesh et al., 2003; Venkatesh et al., 2012) on behaviour intention. This model was used to predict behavioural intentions to use Smartphones as learning tools by comparing two contexts; the College of Engineering (CX1) and the College of Education (CX2). All of the items used in the questionnaire were based on previously conducted research on the UTAUT and UTAUT2 models, as well as the research relating to the adoption and use of technology.

The first stage in the PCA technique helps to test the adequacy of statistical power, sample size and, data readiness for factor analysis. The second stage test checks the measure for sampling adequacy using Kaiser-Meyer-Olkin (KMO) and goodness of fit test using Bartlett sphericity tests (Beavers et al., 2013). The KMO results (0.924*** $P < 0.001$ level.). For factor analysis to be suitable, Bartlett's test of sphericity must be significant ($p<.05$) (Wu, Yu, & Weng, 2012; Wu, Tao, & Yang, 2008). Inaccurate sampling sizes are one of the main reasons for poor model fit, poor reliability and validity of the instrument may also be the reason for a model which displays a poor fit (Hair et al., 2006).

The third stage extracts factors which are in accordance to conforming to the eigenvalue rule. Any factor whose eigenvalue is less than 1.0 will be retained for interpretation (Kaiser, 1958). Kaiser's criterion reasons that a component having an eigenvalue greater than 1 accounts for more variance than a single item. This suggests combining such items into a factor/component in conjunction to the corresponding percentage of the variance explained.

The fourth and the final stage conducts PCA is which variance between the unobserved variables are analysed. This techniques attempts to identify any underlying "factors" using a multivariate analysis procedure that identifies the covariation among a set of independent variables (Joy, 2007). PCA also reduces the number of variables used to explain a relationship, or to determine which variables show a relationship.

4.16.4 Phase-II: Structural Equation Modelling (SEM)

SEM is a series of quantitative methods which allow analysing complex relationships between one or more independent variables with one or more dependent variables (Abdulwahab & Zulkhairi, 2012; Hair et al., 2006). SEM combines factor analysis and multiple regression analysis. Path analysis and multivariate regression are all special cases of SEM (Maruyama, 1997). SEM is a largely confirmatory, rather than exploratory technique (although they have been used as exploratory research tools) (Weston & Gore, 2006). As described earlier the SEM involved four steps which begins with testing for Model Fit and Goodness of Fit followed by testing of the Validity and Reliability of the model. The third step in the CFA is developing the Structure Model (Multivariate Regression) and the final fourth step tests the Hypotheses (Z-Score Group Difference test) in this research.

Structural equation modelling for this research was divided into two parts, the measurement model and a structural model (Cheeseman & Oldford, 2012). Relationships between measured variables and latent variables are structured in a measurement model, while the structural model deals solely with the relationships between latent variables. Before proceeding to build the measurement model for the confirmatory factor analysis (CFA), the best set of variables are extracted using appropriate factor extraction methods (Byrne, 2013; Hair et al., 2006; Hooper, Coughlan, & Mullen, 2008; Kline & Santor, 1999). The second step is to assess the fit of the model.

4.16.5 The Four Stages of SEM Development

Many social science researchers prefer to conduct structural equation modelling with stage of model specification, identification, estimation, testing, modification, and by developing measurement and structural models on established theory or a priory (Schumacker & Lomax, 2004). The structural model examines the relationship between latent variables. SEM analysis often utilises the multiple step approach and establishes measurement model fit, before testing the structural model. This research identified four stages for conducting CFA.

The first stage includes Model Specification and Model Estimation. Model specification involves using all relevant theories and research information to construct a theoretical model. Model identification refers to the loads on an individual construct. A measurement model is the part of the model that examines relationships between the latent variables and their measures. The Model Estimation step involves estimating the parameters in the measurement model in order to compute the sample regression weights for the independent predictor variables. It is assumed here that there are no missing data and no outliers in the sample data. There are five known methods of model estimation:

1. Diagonally Weighted Least Squares
2. Unweighted Least Squares
3. Normal Theory Generalized Least Squares
4. Maximum Likelihood for Multivariate Normal Distributions
5. Weighted Least Squares for Arbitrary Distributions

The second stage includes Model testing which involves determining the fit of the theoretical model by examining the extent to which the theoretical model favours the collected sample data supporting that model (Browne & Cudeck, 1992). The common fit indices included for this research are; goodness of fit index (GFI), the normed fit index (NFI), the comparative fit index (CFI), the root mean square of approximation (RMSEA), the root mean square residual (RMR), and standardized root mean square residual (SRMR). These fit indices have differing scales and norms for indicating model adequacy. Many sources provide guidance for interpreting the various fit indices (Hair et al., 2006; Hooper et al., 2008; Schumacker & Lomax, 2004; Weston & Gore, 2006).

The third stage deals with developing a structure model which is a path diagram with the dependent and independent variable relationships as per the adopted UTAUT2 model. This step conducts path analysis and the resultant significant regression path coefficients which will be used to assess the hypothesise of this research. The final fourth stage of CFA will then test the four sets of hypothesis. The first hypothesis set will be tested by reporting the significant levels of path coefficients. The other three sets of hypotheses will be tested, using Z-score group comparison testing, which is discussed in detail in the conclusion and discussion chapter of this thesis.

4.16.6 Hypothesis Testing Criteria

The structural model developed in the CFA third stage depict correlations among dependent and independent variables which are identified with positive or negative directions (Byrne, 2013).

In this study, the two groups' path coefficients (regression weights) are computed to generate a z-score. The ratio of this group difference test must exceed +/-1.96 in order for the relationship to be judged significant as shown in Table 29.

Table 29: Critical P-Values and Z-Scores for Different Confidence Levels

Z-score (Standard Deviations)	P-value (Probability)	Confidence level
< -1.65 or > +1.65	< 0.10	90%
< -1.96 or > +1.96	< 0.05	95%
< -2.58 or > +2.58	< 0.01	99%

To reject the null hypothesis, the this research will make a subjective judgment regarding the degree of risk to accept for falsely rejecting the null hypothesis. This thesis adopts a range of 0.01, 0.05 and 0.1 levels of confidence to reject the null hypothesis. The Table 29 shows the critical p-values and z-scores for different confidence levels.

4.17 Chapter Summary

This chapter discussed the research methodology adopted for this study. The nature of this research is comparative descriptive design approach. The strategy, the type of data and the analysis method adopted was quantitative comparison between two groups intention to accept Smartphones as mobile learning tools. The model adopted is UTAUT2 and the survey instrument was a developed after conducting a Pre-Pilot and Pilot study. Data was collected after employing opportunity sample techniques, with responses from 300 participants. The study measured seven independent constructs of the UTAUT2 model against the dependent variable (Behaviour Intention). The data analysis includes descriptive and inferential statistical techniques. The inferential analysis commenced by conducting factor analysis in order to identify the best set of variables for each measured parameter, tested the model fitness and finally validated the instrument using confirmatory factor analysis technique. To test the hypothesis of this research, the validated data was path analysed and compared with group difference test. The next chapter will discuss the descriptive and inferential statistical analysis and results in detail.

Chapter 5

5.0 Results

5.1 Introduction

This chapter presents the results from the four parts of the survey (Parts A, B, C and D). Part A recorded demographic data; Part B collected information regarding respondents' views on using Smartphones for educational purposes; Part C acquired data on the current usage of Smartphones; Part D was designed as the main survey instrument.

Part D utilised the UTAUT2 model for technology to access the acceptance of Smartphones in educational institutions. As explained in the research methodology chapter, this thesis aims to investigate technology acceptance by comparing two different contexts; – the College of Engineering (CX1) and the College of Education (CX2). The results chapter is organized into three sections as described below:

1. **Section 1: Questionnaire Descriptive Statistics**
    a. Questionnaire (Part A): Demographic Data Descriptive Analysis
    b. Questionnaire (Part B): Student Opinions Relating to Smartphone Use in Educational Institutions
    c. Questionnaire (Part C): Frequency of Student Use of Smartphones
2. **Section 2: Questionnaire Part D: Inferential Statistics**
    a. **PCA:** Extracting the Best Set of Factors using Principal Component Analysis
    b. **CFA:** Confirmatory Factor Analysis
3. **Section 3: Questionnaire Part D: Structural Model (Multivariate Regression)**
    a. Regression Analysis: Hypothesis, Set I
    b. Regression Analysis: Hypothesis, Set II
    c. Regression Analysis: Hypothesis, Set III
    d. Regression Analysis: Hypothesis, Set IV

The first section explains how the data was collected, logged and screened. It provides descriptive statistics and demographic information from Part A of the questionnaire. It also examines the students' impressions of using Smartphones for educational purposes, as assessed in Part B of the survey, as well as the feedback gained from students about their current use of Smartphones.

Section two describes two important aspects of data analysis from Part D of the questionnaire. Foremost, it describes the best set of variable extraction (extraction of the best set of items or questions using Principal Component Factor Analysis or PCA). The second part defines the Confirmatory Factor Analysis (CFA). The CFA model confirms the appropriateness of the extracted items from the PCA. Section two concludes by validating the extracted set of questionnaire items, the reliability of the instruments used to collect the data and the results. Section three explains the Structural Model (Paths) which were used for multivariate regression analysis to test the four sets of hypotheses used in this thesis.

5.2 Hypothesis Formulation

1. **Set I: "UTAUT2" Constructs and their Significance on Total Population Sample (CX1+CX2)**
2. **Set II: Effect of Moderators on Total Population (CX1+CX2)**
    a. Gender CX1+CX2 (M:W)
    b. Educational Level CX1+CX2 (UG:PG)
3. **Set III: Inter Moderation Or Effect of Moderators Between the Two Contexts**
    a. **Context (CX1:CX2)**
    b. Gender CX1(M:W):CX2(M:W)
    c. Educational Level CX1(UG:PG):CX2(UG:PG)
4. **Set IV: Intra Moderation or the Effect of Moderator Elements Between the Two Contexts**
    a. Gender
        i. CX1(M):CX2(M)
        ii. CX1(W):CX2(W)
    b. Educational Level

i. CX1(UG):CX2(UG)
ii. CX1(PG):CX2(PG)

As explained earlier, this thesis aimed to test four sets of hypotheses (Set I, II, III and IV). This thesis adopts a minimum significance level alpha of 0.05. However, this research has also reported significance levels of 0.01 and 0.001 as supporting assertions. All of the descriptive statistics of this study are measured by means, standard deviations, variance, frequency and percentages to explain results.

The main study questionnaire responses were analysed using Principal Components Factor Analysis (PCA), a factor extraction method. Results were also tested for reliability and model validity. This chapter tests all four sets of hypotheses using path analysis (regression) techniques. .

A detailed analysis of the thesis' hypotheses and findings are provided in the final chapter of this thesis. All four sets of hypotheses, and their respective statistical results, are also presented in this chapter. This thesis uses a two sample Z-Test technique to further analyse the results. This research takes the two sample Z-Test, evaluates the null hypothesis, which contends that that there are no differences between the two populations, or that the effect of any differences between the two groups is insignificant.

5.3 Section 1: Descriptive Statistics (Questionnaire Parts A, B and C)

Data were collected over a six month period. The final questionnaire was distributed after pre-Pilot and Pilot testing. These two preliminary tests were intended to validate the initial content reliability and consistency and to check how long it would take to administer the questionnaire before it was given to the sample population. The Pre-Pilot and Pilot study, results and observations enabled the survey to be fine-tuned. The Pre-Pilot and the Pilot studies were also conducted to achieve the acceptable levels of face validity, reliability and consistency for the final administration of the questionnaire to the survey population.

The total number of students enrolled in the university at the time of the survey equalled 14,725, of which 11,943 were full time students. A further breakdown of the students enrolled in the university showed that 9,721 were undergraduates (81%), while 2,222 were enrolled as postgraduates (19%). The participants in this study come from two colleges of the University of Canterbury - the College of Education [1,852 respondents (16%)] and the College of Engineering [2,849 respondents (24%)]. Their enrolment took place during the 2014 academic year.

The development and testing of the survey instrument focussed on its proper fit for the statistical analysis methods to be used in the data analysis. The final questionnaire instrument was based on the UTAUT2 model, the details of which can be found in Appendix D. This study distributed a total of 1170 questionnaires and received 311 responses. Approximately 99% of the questionnaire was answered on paper, and 1% was answered online. A cover letter informed and instructed students about the scope of the survey. A total of 12 questionnaires were invalidated due to incomplete submissions. A detailed description of the data sample and descriptive information is illustrated in Table 30. The frequency column summarises the total number of cases..

Table 30: Descriptive Statistics of the Total Sample of this Study

Variables	**N**	**Mean**	**Std. Deviation**
	Statistic	**Statistic**	**Statistic**
Performance Expectancy (PEX01)	299	2.63	1.020
Performance Expectancy (PEX02)	299	2.32	1.112
Performance Expectancy (PEX03)	299	2.80	1.036
Performance Expectancy (PEX04)	299	2.31	1.072
Performance Expectancy (PEX05)	299	1.82	1.294
Performance Expectancy (PEX06)	299	2.18	1.160
Effort Expectancy (EEX01)	299	2.86	.974
Effort Expectancy (EEX02)	299	2.53	1.018
Effort Expectancy (EEX03)	299	2.63	1.071
Effort Expectancy (EEX04)	299	2.28	1.145
Effort Expectancy (EEX05)	299	2.41	1.157
Social Influence (SI01)	299	1.57	1.358
Social Influence (SI02)	299	1.61	1.327
Social Influence (SI03)	299	1.40	1.258
Social Influence (SI04)	297	1.99	1.440
Social Influence (SI05)	299	1.63	1.328

Social Influence (SI06)	299	1.69	1.254
Social Influence (SI07)	299	1.57	1.289
Social Influence (SI08)	299	1.78	1.313
Social Influence (SI09)	299	1.75	1.400
Social Influence (SI10)	299	1.81	1.346
Social Influence (SI11)	299	1.66	1.350
Social Influence (SI12)	299	1.78	1.360
Facilitating Conditions (FC01)	299	2.67	.927
Facilitating Conditions (FC02)	296	2.97	.825
Facilitating Conditions (FC03)	294	2.47	1.159
Facilitating Conditions (FC04)	299	2.02	1.163
Facilitating Conditions (FC05)	299	3.14	.830
Facilitating Conditions (FC06)	299	2.55	.987
Facilitating Conditions (FC07)	295	2.54	1.040
Facilitating Conditions (FC08)	299	2.48	1.044
Facilitating Conditions (FC09)	299	2.46	1.014
Facilitating Conditions (FC10)	299	2.70	.942
Facilitating Conditions (FC11)	299	2.36	1.186
Facilitating Conditions (FC12)	299	2.72	1.015
Facilitating Conditions (FC13)	299	2.60	1.033
Facilitating Conditions (FC14)	299	2.62	1.040
Facilitating Conditions (FC15)	299	2.63	.992
Facilitating Conditions (FC16)	299	2.93	.963
Facilitating Conditions (FC17)	299	2.78	.981
Hedonic Motivation (HM01)	299	2.25	1.263
Hedonic Motivation (HM02)	297	2.19	1.239
Hedonic Motivation (HM03)	299	2.18	1.219
Hedonic Motivation (HM04)	299	2.12	1.260
Hedonic Motivation (HM05)	299	2.16	1.151
Hedonic Motivation (HM06)	299	2.10	1.288
Price Value (PR01)	299	2.31	1.196
Price Value (PR02)	299	2.52	1.202
Price Value (PR03)	299	2.37	1.150
Price Value (PR04)	299	2.34	1.203
Habit (HA01)	298	2.44	1.045
Habit (HA02)	299	1.86	.945
Habit (HA03)	299	2.03	1.096
Habit (HA04)	299	2.54	1.037
Habit (HA05)	299	2.61	1.161
Habit (HA06)	299	3.04	.935
Behaviour Intention (BI01)	299	2.51	1.047
Behaviour Intention (BI02)	299	2.20	1.130
Behaviour Intention (BI03)	299	2.51	1.063
Behaviour Intention (BI04)	299	2.59	.994
Behaviour Intention (BI05)	299	2.43	1.128
Behaviour Intention (BI06)	298	2.63	1.065

5.3.1 Data Screening

In order to ensure that the data is clean for conducting multivariate regression analysis, it is first screened for accuracy, usability and consistency. The next step of the data screening phase deals with ensuring the reliability and validity of the survey instrument. Data was inspected visually for possible bias, outliers and any other possible errors. Eleven cases were excluded from the study as they did not include the complete details of the respondent's college name, educational level or gender.

IBM SPSS 22 and Microsoft Excel 2010 software applications were used throughout the descriptive data analysis of all the sections of the questionnaire and for conducting factor analysis. Initial data entry was done in Microsoft Excel 2010 as it offers intuitive tools, interface and techniques in order to simplify data entry, check its consistency and missing data. It offers excellent data handling and superb data backup.

5.3.2 Missing Data

Respondents might neglect some questions or choose not to answer them, possibly due to stress, fatigue, sensitivity or lack of information; this data, or lack of it, is termed "missing data" (Schlomer, Bauman, & Card, 2010). A lack of response is considered a missing value, and a good understanding of such missing values is critical to efficient data management. Inaccurate results could result if missing values are not properly handled .

There are many techniques used to manage missing data. One of these is the list wise deletion method that requires discarding any record missing from one variable. Another technique is the pairwise deletion for bivariate correlations where statistics are calculated based on existing pairwise data. Mean substitution is a technique where the mean value is substituted for the missing variable. There are also regression methods which are used to develop regression equations built upon complete cases for each variable. These equations are used to predict missing values.

Only 22 items from 18538 items in the questionnaire set (62 questions X 311 respondents = 19282 responses) were missing. However, these missing items did not affect the analysis of the data. No corrective measure was taken on data missing from the demographic section. This situation was due to student error where a single question would be answered twice and the preceding or following question would be unmarked. The recommended percentage of any missing data is 5% to 10%, and the missing data in this thesis amounted to 0.15% which is favourable (Sekaran, 2006). The number of questions with missing data was studied; 28 items had missing data from nine questionnaires, which is considered insignificant with respect to 299 cases for each item. This percentage of missing data was not a problem.

Demographic data was acquired for all of the respondents leaving three exceptions. Missing data appears in most studies related to behavioural science (Acock, 2005; Allison, 2001). The American Psychology Association (APA) suggests that researchers should report missing data configurations and the underlying techniques used to challenge this difficulty (Brulhart & Klein, 2005; Wilkinson, 1999).

Previously, popular data analysis applications and software that were used to analyse missing data were complex and expensive. Now, tackling missing data can be more easily achieved using cheaper and more powerful computing resources. Even though the proper reporting and handling of missing data is essential for data analysis, this is often omitted from research reports. However, in the case of this thesis, the levels of missing data were negligible, rendering such efforts unnecessary.

5.3.3 Normal Distribution Assessment

While it is essential to assess normality at the outset of data analysis, the main point of interest is to check for outliers and linearity (Field, 2009). Before starting with the multivariate analysis technique, it is assumed that the data is normally distributed, and the two indicators of normality are skewness (bias) and kurtosis (Mardia, 1970). The curve is normally distributed as a bell-shaped curve with the graph falling off evenly on either side of the mean with zero skewness and kurtosis. This research notes that positively skewed distribution curves illustrate scores clustered to the left, with the tail extending to the right. A negatively skewed distribution curve shows scores clustered to the right, with the tail extending to the left corresponding to the values of the Likert scale used in this research (Garson, 2012).

A consistent negative skewness was displayed, which indicated that a higher number of students agreed to all the variables of the study. This is further supported by the large variable means which indicate that most of the variables have been agreed with (10% strongly agree, 47% agree, 16% have no opinion, 22% disagree and 5% strongly disagree). No apparent outliers were detected, as shown in Figure 19.

The results relating to the normality test for sample two indicated that the maximum and minimum absolute values of skewness were 0.143 and -1.167 respectively (See Appendix E). The range of values were well below their respective cut-offs of 3 for skewness and 8 for kurtosis as suggested by (Weston & Gore, 2006). Hence it can be inferred that the data sample variables for the two contexts of the study were approximately normally distributed.

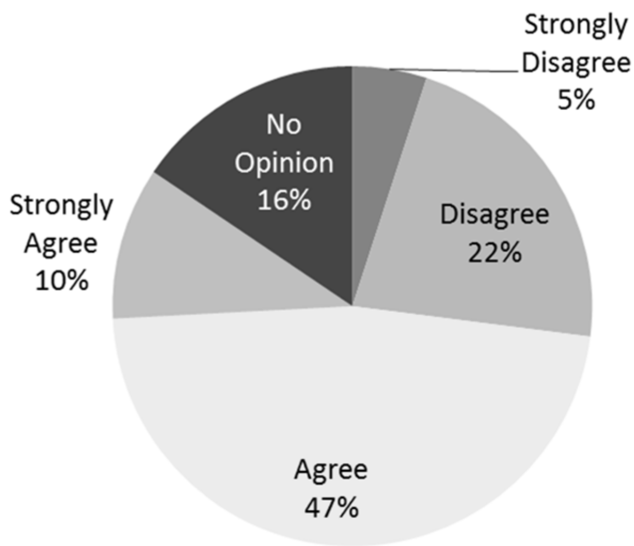

Figure 19: Percentage of Student Response for all of the Survey Questions

The results pertaining to the normality test for sample one indicated that the maximum absolute values of skewness and kurtosis were 2.715 and -1.560 respectively (see Appendix E); except for two items which were above 2.5 skewness levels. All the values were well below their respective cut-offs of 3 for skewness and 8 for kurtosis as suggested by (Hooper et al., 2008), implying that the observed variables in sample one were normally distributed.

Often, researchers report that each of the univariate distributions have skew and kurtosis within reasonable ranges. Different rules of thumb have been given suggested (based on various simulation studies for factor analysis type models). Kline and Santor (1999) state that skew > 3 is extreme skewness and kurtosis > 10 is extreme kurtosis.

5.3.4 Outliers

Outliers are values that differ significantly from the majority of the data set and may fall outside the overall trend. Outliers are generally caused by measurement error; or they may indicate the presence of an unknown phenomenon.

Only two outliers were identified in the demographic section of the data set of this study by examining the Tables produced from the SPSS for the observed variables. According to Anderson, Chu, and Weitz (1987) if outliers are a section of the population, these outliers should be included in order to ensure generalisability of the entire population. The outliers identified in this thesis were retained in the data set. True normality is an ideal that is technically rare. Data that shows a reasonable departure from normality can be used in parametric procedures without losing validity (Elliott & Woodward, 2007).

5.3.5 Evaluating Correlation Matrix

The correlation matrix of all the construct items were assessed by visual inspection individually (see Appendix F). The analysis of this matrix shows substantial significant correlations above 0.30 for all the items except effort expectancy (EE05) and facilitating conditions (FC04) (Pallant, 2007). The data collected in this thesis can be analysed and developed using the structural equation model (SEM) to test the research hypotheses.

5.4 Questionnaire Part-A: Demographic Data Analysis:

Table 4 presents the frequencies among respondents' demographic data (i.e., gender, age, university enrolment level) as well as the current year of study, Smartphone ownership, Smartphone make, duration of Smartphone use in years, Smartphone operating system, Smartphone expertise and student awareness of online learning resources. The frequency column summarises the total number of cases while the other column displays this frequency in percentage form. The Engineering department consists of Chemical and Process Engineering, Civil Engineering, Computer Engineering, Electrical and Electronic Engineering, Forest Engineering, Mechanical Engineering, Mechatronics, Natural Resources Engineering, and Software Engineering.

The Education department consists of The School of Teacher Education, The School of Sport and Physical Education, The School of Health Sciences, and the School of Educational Studies and Leadership. This research hypothesises that the two contexts, gender and educational levels, are more likely to moderate the behaviour intention of the student to use Smartphones. Approximately 99% of the survey responses were answered on paper, with only 1% answered online. The students were thoroughly guided and informed about the scope of the survey via a cover letter. As noted above, a total of 12 questionnaires were invalidated owing to incomplete submission. This is illustrated in Table 31.

Table 31: Respondents gender distribution (Total Sample):

No	SECTION-A Question-01	CX1 (133)		CX2 (166)	
1	**Gender**	**Frequency**	**%**	**Frequency**	**%**
	Female	30	23%	111	67%
	Male	103	77%	55	33%

There were 133 respondents in CX1 and 166 respondents in CX2. In CX1, females made up 23% of the respondents and males made up 77%. In CX2, females made up 67% of the respondents and males made up 33%. The difference in percentages between the two contexts portrays an ideal contrast of gender, where the number of females in CX1 is balanced by the number of females in CX2 and the number of males in CX1 is balanced by the number of males in CX2, as shown in Table 32.

Table 32: Respondents' Age Group

		CX1 (133)		CX2 (166)	
2	**Age**	**Frequency**	**%**	**Frequency**	**%**
	Below 18	1	1%	0	0%
	18-20	42	32%	60	36%
	21-25	54	41%	55	33%
	26-30	21	16%	16	10%
	31-40	15	11%	19	11%
	Over 40	0	0%	16	10%

The respondents were divided into six age groups; below 18, 18-20, 21-25, 26-30, 26-30, 31-40, and those over 40. This grouping was done after obtaining feedback from the Pre-Pilot survey. Of these age groups, 21-25 showed the highest rate of response in both contexts (CX1 - 41%, CX2 - 33%), followed by the age group 18-20 (CX1 - 32%, CX2 - 36%) while almost no response was received from those below 18. The age group below 18 showed almost no response in both contexts, with CX1 showing only 1% and CX2 showing nothing.

It was observed that the population was the highest for the respondents aged 18-25 with a percentage of 70 for each of the two contexts. The data also showed an almost equal distribution between two of the age groups (18-20 and 21-25) of the two contexts. Between the two contexts, the age group 21-25 showed a slightly higher percentage of respondents in CX1, while the 18-20 age group showed a slightly higher percentage of respondents in CX2. The age groups 26-30 and 31-40 displayed a lower rate of response (in both contexts), with a percentage ranging between 10%-16%; with the age group 26-30 in CX1 displaying a higher percentage of 16. The age group over 40 from CX1 was absent, while in CX2 they accounted for 10% of the respondents.

The third question was designed to determine students' educational levels, and was divided into undergraduates and postgraduates. The postgraduate category included both Master's and PhD students. Undergraduates in CX1 and CX2 showed a response rate of 68% and 76% respectively while postgraduates in CX1 and CX2 showed a response of 31% and

24%. These responses reflect the total university enrolment of undergraduates and postgraduates (CX1 and CX2) focused on in this study, as demonstrated in Table 33.

Table 33: Respondents' Education Levels

		CX1 (133)		**CX2 (166)**	
3	**I am currently enrolled in**	**Frequency**	**%**	**Frequency**	**%**
	Undergraduate	91	68%	126	76%
	Postgraduate (Masters+PhD)	42	31%	40	24%

The fourth question sought to determine the student's current year of study . Second year students were the highest respondents in both contexts (CX1-39%, CX2-46%), followed by first year students (CX1-30%, CX2-13%), and then by fourth year students (CX1-17%, CX2-17%), as shown in Table 34.

Table 34: Respondent's Year of Study

		CX1 (133)		**CX2 (166)**	
4	**Year of study for current programme**	**Frequency**	**%**	**Frequency**	**%**
	First	40	30%	22	13%
	Second	52	39%	77	46%
	Third	18	14%	38	23%
	Fourth	23	17%	29	17%

The fifth question asked whether respondents owned Smartphones. This was a significant question in order to discover the ownership of Smartphones in these colleges, and whether their popularity followed the global trend as evident in the literature review of this study. Around 95% of the respondents from both contexts owned Smartphones, thus proving their universal usage as shown in the Table 35.

Table 35: Respondents Smartphone and Tablet Ownership

		CX1 (133)		CX2 (166)	
5	**I own a Smartphone/Tablet**	**Frequency**	**%**	**Frequency**	**%**
	Smartphone	102	77%	114	69%
	Tablet	5	4%	1	1%
	Both	23	17%	44	27%
	None	3	2%	7	4%

The sixth and seventh questions were designed to determine the make and operating software of respondents' Smartphones. The literature review has confirmed that Apple and Samsung Smartphones currently dominate the market. iPhone users in CX1 made up a percentage of 36% which was nearly half that of the iPhone users in CX2 with a percentage of 51%. There were almost as many Samsung users in CX1 (38%) as iPhone users in CX1 (36%). In CX2, 32% of the Smartphone users preferred Samsung which is again almost half that of the iPhone users in CX2 (51%). In CX1 no particular brand of Smartphone seemed to dominate, while in CX2 the iPhone appears to be the preferred brand, as shown in Table 36.

Table 36: Smartphone Make and Operating System

		CX1 (133)		CX2 (166)	
6	**My Smartphone is (make)**	**Frequency**	**%**	**Frequency**	**%**
	iPhone	48	36%	84	51%
	Samsung	50	38%	53	32%
	Other	34	26%	25	15%
7	**My Smartphone Operating System is**	**Frequency**	**%**	**Frequency**	**%**
	Android	80	60%	76	46%
	Apple iOS	48	36%	84	51%
	WinOS	2	2%	2	1%
	Other	2	2%	0	0%

The eighth question asked about the respondent's Smartphone ownership. The majority of the Smartphone users from both contexts had owned Smartphones for at least 3-4 years (CX1-40%, CX2-41%). This was followed by respondents who had owned Smartphones for around 1-2 years (CX1-35%, CX2-36%). The least percentages were for respondents who had owned Smartphones for 7-8 years (CX1-3%, CX2-2%), as shown in Table 37.

Table 37: Years of Ownership of Smartphones

		CX1 (133)		CX2 (166)	
8	**I am using my Smartphone since last**	**Frequency**	**%**	**Frequency**	**%**
	7-8 Yrs	4	3%	4	2%
	5-6 Yrs	10	8%	8	5%
	3-4 Yrs	53	40%	68	41%
	1-2 Yrs	47	35%	60	36%
	less than a year	18	14%	22	13%

The ninth question examined the user's competency with using Smartphones. Almost 90% of the respondents from both contexts expressed their range of skills at using Smartphones as good to expert (see Table 38). The last question focused on the respondent's awareness and knowledge of free available online learning resources. Almost 75%-65% of the respondents from both contexts were well aware of popular online resources. This is illustrated in Table 39. These popular resources were listed from the literature review.

Table 38: Smartphone User Expertise

		CX1 (133)		CX2 (166)	
9	**My skill in using a Smartphone is**	**Frequency**	**%**	**Frequency**	**%**
	Expert User	39	29%	28	18%
	Good User	84	63%	119	72%
	Limited User	9	7%	16	10%

Table 39: Respondents' Awareness of Online Resources

		CX1 (133)		CX2 (166)	
10	**I am aware of the following FREE online learning resources**	**Frequency**	**%**	**Frequency**	**%**
	Open Courseware (OCW)	2	2%	1	1%
	Open Education Resources (OER)	3	2%	0	1%
	MIT Open Education Resources	7	5%	13	8%
	Khan Academy	30	23%	2	1%
	Coursera	3	2%	0	0%
	Massive Open Online Courses (MOOCs)	24	18%	29	17%
	iTunesU	31	23%	86	52%
	None	33	25%	33	20%

5.5 Questionnaire Part B Data Analysis: Students' Smartphone Use

Part B of the questionnaire was aimed at assessing the participant's acceptance of using Smartphones for academic and learning activities. There were 14 questions in Part B of the survey instrument (see Appendix D for precise details of the survey). It was expected that investigating student opinion with *direct* questions regarding the use of Smartphones for education would provide insight into their use. The questions dealt with the students' ideas and perceptions of whether they would use Smartphones for academic activities, such as reading books, recording lectures and accessing educational resources.

The 14 direct questions in Part-B were designed to garner student opinion regarding the use of Smartphones in education. These questions were designed after conducting an extensive literature review to determine their significance. Both contexts of this study (CX1 and CX2) strongly agreed to the use of Smartphones in education, with 9 of the 14 questions scoring more than 70% in agreement.. However, answers to all the 14 questions from section B revealed that CX2 was more inclined than CX1 towards using Smartphones in academics, as shown in Table 40.

Table 40: Questionnaire Part-B: Student Responses

PART-B	Questions	Context	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Q1	Mobile apps (applications) for learning	**CX1**	21%	52%	9%	2%	2%
		CX2*	**19%**	**67%**	7%	2%	4%
Q2	Taking notes during lectures	**CX1**	11%	28%	23%	11%	7%
		CX2*	**12%**	**38%**	33%	10%	5%
Q3	Reading eBooks	**CX1**	9%	42%	19%	2%	6%
		CX2*	**16%**	**55%**	20%	5%	4%
Q4	Using online resources	**CX1**	26%	48%	4%	1%	1%
		CX2*	**35%**	**53%**	7%	2%	2%
Q5	Searching for educational resources	**CX1***	20%	47%	9%	0%	2%
		CX2	**33%**	**55%**	8%	2%	2%
Q6	Viewing Video or Audio recorded lectures	**CX1**	16%	32%	20%	6%	5%
		CX2*	**26%**	**55%**	13%	3%	2%
Q7	laboratory experiments and Data logging	**CX1**	11%	35%	21%	5%	8%
		CX2*	**13%**	**51%**	23%	2%	10%
Q8	Taking Assessments, quiz, surveys and polling	**CX1**	17%	37%	21%	2%	3%
		CX2*	**17%**	**60%**	17%	4%	2%
Q9	Submitting assignments	**CX1**	11%	26%	27%	8%	7%
		CX2*	**16%**	**37%**	28%	12%	5%
Q10	Asking questions to the lecturer	**CX1**	13%	43%	14%	4%	6%
		CX2*	**19%**	**63%**	11%	4%	3%
Q11	Communicating with friends for educational	**CX1**	26%	44%	5%	1%	2%
		CX2*	**39%**	**53%**	5%	1%	1%
Q12	Using Social Networking for learning	**CX1**	17%	53%	5%	1%	3%
		CX2*	**33%**	**54%**	7%	3%	2%
	Collaborating online for learning	**CX1**	17%	48%	8%	2%	4%
		CX2*	**27%**	**61%**	8%	2%	1%
Q14	Collaborating with faculty for educational	**CX1**	17%	43%	14%	1%	5%
		CX2*	**21%**	**60%**	12%	2%	4%

Breaking down the more prominent CX2 responses revealed that 53% agreed to the use of Smartphones for communicating with friends for educational help, while 39% strongly agreed to it. Fifty-three percent of CX2 students agreed that they accessed online resources using Smartphones while 35% strongly agreed to it. When it came to searching for educational resources using Smartphones, 55% agreed to it while 33% strongly agreed. Fifty-four percent of the students agreed to the use of Smartphones for social networking in education, while 33% agreed strongly to it.

Most of the responses to Q2, Q7 and Q9 scored around 50% to 60% agreement in CX2. The findings indicate that 38% of CX2 students agreed to use Smartphones for taking notes during lectures, while 12% agreed strongly to it. Fifty-one percent agreed to using Smartphones for laboratory experiments and data logging, while 13% strongly agreed to it. Thirty-seven percent of students agreed to using Smartphones for submitting assignments, while 16% strongly agreed to it.

5.6 Questionnaire Part-C Data Analysis: Student's Use of Smartphones

Section C assesses respondents' current and real usage of Smartphones. This part of the questionnaire was designed to evaluate the most commonly accessed online activities through Smartphones.

The scale of the response was based on usage, namely: very often, often, sometimes, rarely and never. There were a total of ten questions. The comparative analysis of the two contexts of this study showed that Q1 (checking emails), Q6 (listening to music), Q8 (social networking) and Q9 (online banking) registered the highest percentage of positive responses, with 70%-80% of respondents from both contexts, showing often to very often usage. The response to Q1 was almost equal across both contexts, while in Q6, Q8 and Q9, CX2 showed a higher response (see Table 41). The Table below illustrates the percentage of the response scale for the two contexts.

Table 41: Questionnaire Part-C: Students Responses

PART-C	Questions	Context	Very Often	Often	Sometimes	Rarely	Never
Q1	Checking emails	**CX1***	**63%**	**21%**	5%	7%	2%
		CX2	62%	19%	8%	5%	5%
Q2	Reading eBooks	**CX1***	**5%**	**18%**	23%	26%	26%
		CX2	8%	9%	23%	28%	30%
Q3	Distributing Files	**CX1***	**8%**	**26%**	26%	25%	14%
		CX2	6%	17%	31%	23%	22%
Q4	Accessing Educational Content	**CX1**	12%	35%	24%	20%	8%
		CX2*	**14%**	**32%**	32%	11%	8%
Q5	Playing Games	**CX1***	**20%**	**23%**	29%	17%	9%
		CX2	22%	13%	23%	23%	18%
Q6	Listening to Music	**CX1**	40%	32%	18%	6%	2%
		CX2*	**45%**	**26%**	14%	8%	6%
Q7	Watching Movies	**CX1**	7%	13%	26%	34%	20%
		CX2*	**11%**	**11%**	25%	17%	34%
Q8	Social Network (Facebook, Twitter etc.)	**CX1**	60%	23%	8%	5%	3%
		CX2*	**65%**	**19%**	7%	4%	5%
Q9	Online Banking	**CX1**	35%	38%	14%	7%	5%
		CX2*	**52%**	**22%**	9%	9%	7%
Q10	Online Shopping	**CX1**	8%	21%	26%	20%	23%
		CX2*	**13%**	**17%**	25%	23%	21%

** greatest percentage between both context (i.e. CX1*> CX2)*

Q4 and Q5 had a response of 40%-45% across both contexts, with usage ranging from often to very often. Q4 had a higher response from CX2 and Q5 had a higher response from CX1.

Q2, Q3, Q7 and Q10 displayed a response of 25% - 35%, with usage ranging from often to very often. Q2 and Q3 showed a higher response from CX1, while Q7 and Q10 showed a higher response from CX2. An overall analysis of Part-C reveals that with Q4, Q6, Q7, Q8, Q9 and Q10, CX2 showed a use ranging from often to very often.

Parts A, B and C clearly indicate that students believe that the Smartphone is a useful tool for education. The descriptive data analysis also indicated that students believed that Smartphone-based mobile learning resources are understandable and easy to use. Furthermore, they believe they would help them to collaborate with peers, friends and communities..

The descriptive data also revealed that most of the students were using Smartphones for a number of activities, including communication, distributing files, playing games, listening to music, entertainment and social networking. The descriptive statistics also supported student confidence that they had the necessary resources, knowledge and expertise to use Smartphones for education. Students in this survey believed that m-learning was a good idea and was enjoyable. The three parts of this questionnaire evoked student responses that strongly supported the use of Smartphones as m-learning tools.

5.7 Section 2: Questionnaire Part D

Part D focused on the main set of questions for this thesis. In this part of the survey, questions were designed to analyse the total population sample for hypothesis testing and to validate the efficiency of the UTUAT2 model. Part D was designed to assess the effect of moderators on the acceptance of Smartphones as mobile learning devices in the two contexts.

As explained earlier, the initial data analysis included validating the UTAUT2 model followed by testing the effect of the contexts (the College of Engineering: CX1 and the College of Education: CX2), as well as gender (Men and Women) and educational level (undergraduate and postgraduate). The third set of data compared the effects of these moderators; that is, the differences between opposite genders in a context, as well as the differences between the same gender across the contexts.

As noted elsewhere, the main purpose of this thesis is to test the effect of different contexts (CX1 and CX2) of education to moderate the adoption of Smartphones as mobile learning tools. In CX1, Men constituted 77% of the respondents; while in CX2, they made up 33%. In CX1, Women constituted 23% of the group sampled and in CX2, 67%. Gender was studied as a principal moderator in all of the research using the UTAUT2 model (Alrawashdeh et al., 2012; Pahnila et al., 2011; Venkatesh et al., 2012; Xu, 2014; Yang, 2013).

Educational level is a better representation of age in the educational context. This thesis found that undergraduate students were mostly of similar age, as were the postgraduate population. Study participants were students from the College of Engineering (CX1=133) and the College of Educational Studies (CX2=166), both from the University of Canterbury (see Table 1.0).Data was collected in person, by visiting all of the classrooms of both the contexts. Kiosks were also placed in the library for any student wanting to submit a survey. An online version of the survey was also developed using the university polling application “Qualtrix”. The online link was also distributed to students in the library and student café via handouts .

5.8 Extracting Best-Set of Factors using (PCA)

Any large body of data must be analysed and simplified. Factor analysis is one tool that reduces bulk data into smaller and more manageable chunks called factors.

Once the factors are identified, it is easier to examine the variable belonging to that factor. This association of a set of variable items (dependent or independent) is expressed with a *loading*. A factor loading is simply a correlation coefficient, which tells the researcher the extent to which a question is measuring that factor.

Conducting factor analysis also presents the researcher with challenges. The challenge is to decide on the number of factors to retain as reliable and significant. Factor analysis can become complex when there are a large number of variables at play. Some of the variables may not load with the posited underlying model. This research adopted a four step method to extract the best set of items for each factor using the principal components analysis (PCA) as a factor extraction technique. This extraction technique enabled the researcher to provide the correct sample size, statistical power, data readiness for factor analysis, reliability, validity, goodness of fit and to test the hypotheses from the final extracted set of variables. After using PCA, data was again assessed using confirmatory factor analysis to determine the goodness of fit, reliability and validity.

1. **PCA:** Extracting Best-Set of Factors using Principal Component Analysis
2. **CFA:** Confirmatory Factor Analysis

The PCA technique tests a set of latent factors with the underlying theory, from a large pool of unobserved variables from the survey instrument (Williams et al., 2012; Wold, Esbensen, & Geladi, 1987). PCA extracts all of the factors underlying a set of variables which completely explain the variance in each set. The factors obtained from PCA retain the preeminent information from the survey set and remove redundant information and sampling measurement errors. The grouping and sorting of data for the PCA technique often involves complex procedures and critical decision-making skills. A methodological approach to this complex maze of activities and decisions minimises the chances of interpreting the data wrongly or committing errors (Thompson & Daniel, 1996). The four step extraction flowchart is illustrated in Figure 20.

1. **Stage-One (PCA):** Check for data readiness
2. **Stage-Two (PCA):** Assess adequate sample size and significance
3. **Stage-Three (PCA):** Confirm initial factors based on Eigenvalue criteria
4. **Stage-Four (PCA):** Extract final set of factors based on PCA factor loading criteria

5.8.1 Stage-One (PCA): Check for data readiness

The statistical power of a study is the chance that it will come out statistically significant; this is typically expressed in a percentage form (Cohen, 1977). The likelihood of proving a hypothesis is the aim of a research. A study that has a 0.8 power means that the study has an 80% chance that the test will display a significant result (Schuirmann, 1987).

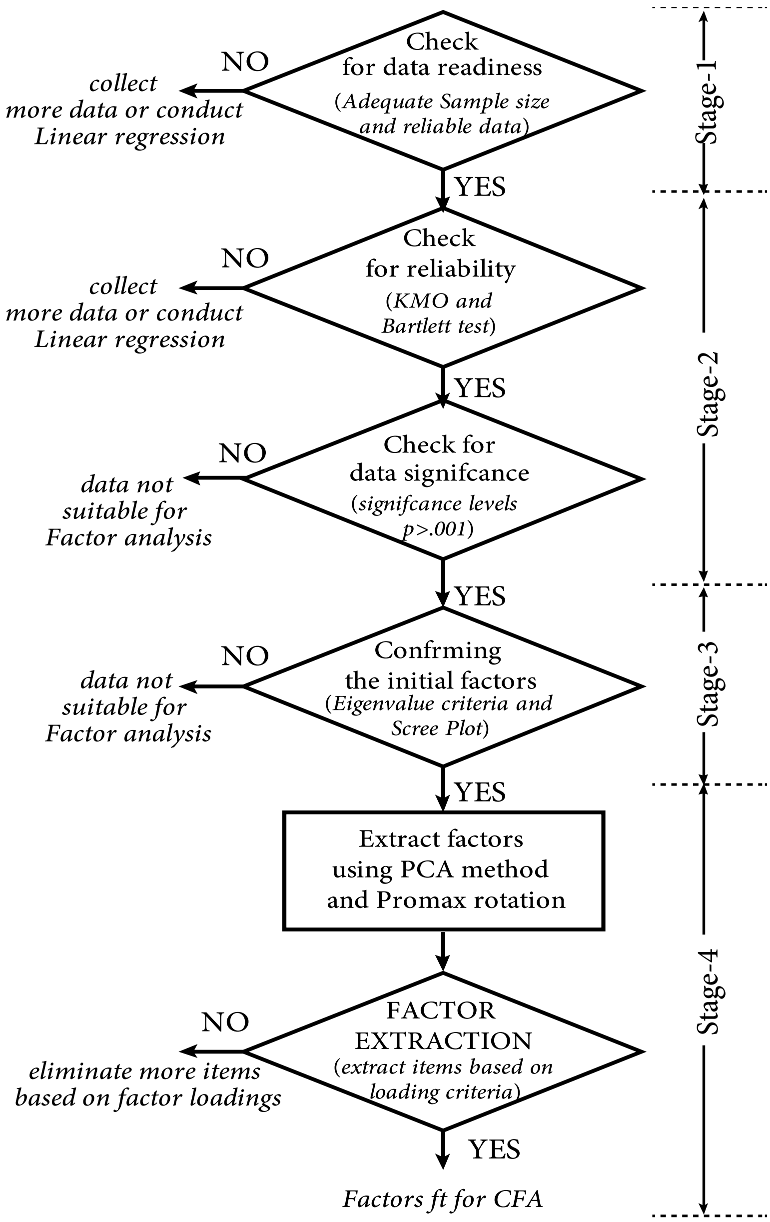

Figure 20: Principal Component Analysis, Flow Chart

A high statistical power means that the test results are likely valid. However, as the power increases, so does the possibility of a Type II error. This research notes that, when testing a hypothesis statistically, a Type I error refers to the incorrect rejection of a true null hypothesis, while a Type II error is the failure to reject a false null hypothesis. A low statistical power means that the test results are questionable. Statistical power also helps you to determine if your sample size is large enough. If the intended population sample size is too small, the results may be inconclusive, whereas the results from a large enough sample are more definite. Determining the statistical power involves all the three variables – the sample size (N), significance criterion (α) and population effect size (ES) where each is a function of the other two.

Sample size is the most critical aspect of factor analysis and is also one of the most unsettled aspects of factor analysis. A literature review of this subject revealed that varying opinions and rules of thumb are used to determine sample sizes (6, 8-10) (Hogarty, Hines, Kromrey, Ferron, & Mumford, 2005 p 203). General guides suggest that having at least 300 cases would be deemed acceptable for factor analysis (Tabachnick & Fidell, 2001). Hair Jr, Anderson, and Tatham (1986) suggest a sample size of 100 or greater.

Although the determination of appropriate sample size is critical for factor analysis involving structural equation modelling (SEM), there is no consensus regarding the appropriate sample size. There is some evidence that simple SEM models could be tested even if the sample size is small (Hoyle, 1999; Hoyle & Kenny, 1999; Marsh & Hau, 1999); but N=100 to 150 is considered the minimum sample size (Anderson & Gerbing, 1988; Ding, Velicer, & Harlow, 1995; Tabachnick & Fidell, 2001; Tinsley & Tinsley, 1987). Some researchers prefer larger sample sizes for SEM (Boomsma & Hoogland, 2001; Hoogland & Boomsma, 1998; Kline & Santor, 1999). In cases with no missing data and a normal distribution of indicator variables, studies have shown that a reasonable sample size for a simple CFA model is N=150 (Muthén & Muthén, 2012). In multi-group models, the normal sample size would be 100 cases per group (Kline & Santor, 1999)

One method for determining the required sample size for a survey is based on the percentage of error that the researcher is ready to accept. A statistical power of at least 95% confidence or an alpha of 0.05 is considered ideal in the field of social sciences. Cohen (1977) determined that a sample of at least 175 participants would be required to achieve this 95% confidence. The sample size depends on the complexity of the model but also on other factors. An alternative set of recommendations also exists which provides tools to researchers regarding the required number of participants for each variable and is termed the sample to variable ratio. This ratio is denoted as N, where N refers to the number of participants and P refers to the number of variables. (Hogarty et al., 2005; Mac

Callum & Jeffrey, 2010) also suggest the same recommendations to variable ratios in order to determine adequate sample sizes. For example, rules of thumb range anywhere from 3:1, 6:1, 10:1, 15:1, or 20:1.

Often good sample size depends on two criteria: the ratio of the number of variables to the number of factors, and the number of the factors to be extracted. In general, over 300 cases are considered adequate for analysis (Field, 2013). This should be taken into consideration, as it can seriously influence the reliability of the extracted factors. Factor analysis is a technique that requires a large sample size. Tabachnick and Fidell (2001) cite Comrey and Lee (1992) for advice regarding sample size: a size of 50 cases is considered very poor, 100=poor, 200=fair and 300 is considered good. This study adopted Cohen's recommended Power of 0.80 for statistical power or higher; which means that there is an 80% chance or greater of finding a significant effect, as well as the α value of .05 and effect size (ES) of .50. The number of sample subjects was set at 300 after considering many research papers and literature reviews of factor analysis, as well as the number of parameter estimates.

5.8.2 Stage-Two (PCA): Assess Adequate Sample Size and Significance

It is important to establish the initial reliability of each measure (Im et al., 2011). For direct measures, one form of reliability may be established using an index of internal consistency. Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. All value-indicators mentioned in Table 42 were well above the prescribed 0.7 as excellent. According to (Henseler, Ringle, & Sinkovics, 2009) Cronbach's alpha should have values higher than 0.7 to be deemed reliable.

Table 42: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**0.935**
Bartlett's Test of Sphericity	Approx. Chi-Square	5308.810
	Df	435
	Sig.	**.000**

The second stage of PCA involves conducting Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity tests to check the measure for sampling adequacy (Beavers et al., 2013). The KMO results (0.924*** $P < 0.001$ level.) surpass the acceptable limit of 0.600. Also, the Bartlett's test of sphericity relates to the significance of the study and thereby shows the validity and suitability of the responses collected to the problem being addressed. For factor analysis to be suitable, Bartlett's test of sphericity must be significant ($p<.05$) (Wu et al., 2012; Wu et al., 2008) as shown in Table 43.

5.8.3 Stage-Three (PCA): Confirming Initial Factors Based on Eigenvalue Criteria

The third stage extracts a set of factors conforming to the eigenvalue rule. Any factor whose eigenvalue is less than 1.0 is not going to be retained for interpretation (Kaiser, 1958). Kaiser's criterion reasons that a component having an eigenvalue greater than 1 accounts for more variance than a single item. This suggests combining such items into a factor/component in conjunction to the corresponding percentage of the variance explained. All the initial eigenvalues greater than 1.0, along with the corresponding percentage of variance column values which were greater than 2.0, were retained as factors as shown in Table 43. However, the components which demonstrated eigenvalues > 1.0 after the seventh component showed marginal (1% to 1.5 %) increments of percentage variance explained.

With this elimination criteria and the UTAUT2 model in mind, the initial solution yielded seven factors, accounting for a total of 59.258 % of the variance explained by the extracted seven factors. This confirmed the seven constructs of the UTAUT2 model used in this thesis (see Table 4.0). According to Kaiser (1960), the requirement that the eigenvalue be greater than 1 was followed, and the factor loading lower cut-off point was set at 0.50 for each item, as suggested by several others (Hair, Sarstedt, Pieper, & Ringle, 2012; Weiwei SHI, 2007; Williams et al., 2012).

Table 43: Total Variance Explained by the PCA Factor Extraction

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Total	% of Variance	Cumulative %
1	24.105	38.879	38.879	24.105	38.879	8.531	13.760	13.760
2	4.075	6.572	45.452	4.075	6.572	7.789	12.563	26.323
3	2.165	3.492	48.944	2.165	3.492	5.330	8.596	34.919
4	1.807	2.915	51.859	1.807	2.915	5.252	8.471	43.391
5	1.711	2.760	54.618	1.711	2.760	3.588	5.787	49.178
6	1.589	2.562	57.180	1.589	2.562	3.210	5.177	54.354
7	1.288	2.078	59.258	1.288	2.078	3.040	4.904	59.258
8	1.185	1.911	61.169					
9	1.160	1.871	63.040					
10	1.093	1.764	64.804					
11	1.005	1.621	66.424					
12	.970	1.565	67.989					
13	.858	1.384	69.373					
14	.849	1.369	70.743					
15	.798	1.288	72.030					
16	.786	1.268	73.298					
17	.754	1.216	74.515					
18	.727	1.172	75.686					
19	.682	1.101	76.787					
20	.658	1.061	77.848					
21	.638	1.028	78.876					
22	.611	.985	79.861					
23	.605	.976	80.836					
24	.584	.941	81.778					
25	.566	.913	82.691					

5.8.4 Stage-Four (PCA): Extracting the Final Set of Factors

The fourth and final stage of PCA deals with examining the communalities and screening the final set of extracted variables using factor extraction criteria, as outlined below.

1. Minimum items loadings on the appropriate factor should be above 0.50
2. Items should not load on multiple factors
3. Items should not demonstrate negative loadings

Once the factor extraction has been completed, the ‘communalities’ are examined to reveal how much of the variance in each of the original variables is explained by the extracted factors. A 75.1 % of the variance in the PX02 (performance expectancy) variable is explained by the extracted components. Any item with less than 50% demonstrated communality for a variable will be excluded from the analysis. This means that the factor solution will contain less than half of the variance in the original variable, and the explanatory power of that variable is not well represented, hence higher communalities are desirable. Table 44 illustrates the initial and final extracted communalities.

By definition, the initial value of the communality in a principal components analysis is 1. The values in this column indicate the proportion of each variable’s variance that can be explained by the principal components. Variables with high values are well represented in the common factor space, while variables with low values are not well represented. The communalities illustrated in Table 44 display all the variables above 0.50. No variable will be excluded on the basis of low communalities. The finalisation of factor extraction in principal component analysis is carried out by using the Promax factor rotation technique and Kaiser normalization. This step primarily eliminates variables which do not load on any factor, or variables that loaded on multiple factors, or variables which load lower than 0.5. With the exception of items of the habit construct which cross loaded heavily with other factors, all the relevant items were retained as listed in Table 45.0.

Table 44: Communalities: Extraction Method: Principal Component Analysis

Items	Initial	Extraction
PE02	1.000	0.751
PE05	1.000	0.660
PE06	1.000	0.780
EE02	1.000	0.790
EE03	1.000	0.769
EE04	1.000	0.666
FC11	1.000	0.648
FC12	1.000	0.739
FC13	1.000	0.708
BI01	1.000	0.765
BI02	1.000	0.752
BI03	1.000	0.676
HD03	1.000	0.868
HD05	1.000	0.739
HD06	1.000	0.733
SI08	1.000	0.689
SI11	1.000	0.775
SI12	1.000	0.782
PRI01	1.000	0.810
PRI03	1.000	0.858
PRI04	1.000	0.797

According to Costello and Osborne (2011), to simplify the factor extraction, the effect of habit was eliminated as a construct. In Table 45 (extracted from SPSS), all of the seven items loaded above 0.5 and most of the 39 variables from the initial set of 62 did not meet the above mentioned criteria (i.e., item loading loaded above 0.5) and were eliminated at this screening level.

The final set of factor extraction was obtained after seven iterations of rotation during the principal component factor (PCA) item analysis and evaluation. Table 46 contains the final extracted factor loading along with their reliability alphas for students' acceptance of Smartphones as learning tools in the two contexts. The number of items was reduced to 21, resulting in a reliability improvement of above 0.90 for all the extracted items. Hair et al. (2006) recommends loadings on the appropriate factor should be above 0.50. Moreover, all the factors combined explained 75% of the total cumulative variance.

Table 45: PCA Pattern Matrix and Extracted Factor Loading

Factors		**Factor Loadings**						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Price (PR)	PR03	0.943						
	PR01	0.888						
	PR04	0.850						
Social Influence **(SI)**	SI11		0.844					
	SI08		0.841					
	SI12		0.837					
Hedonic Motivation (HM)	HM03			0.976				
	HM05			0.791				
	HM06			0.747				
Facilitating Conditions (FC)	FC13				0.852			
	FC12				0.843			
	FC11				0.644			
Effort Expectancy **(EE)**	EE03					0.785		
	EE02					0.727		
	EE04					0.670		
Behaviour Intention (BI)	BI01						0.881	
	BI02						0.874	
	BI03						0.542	
Performance Expectancy (PE)	PE02							0.844
	PE06							0.762
	PE05							0.512

Table 46: Factor Matrix and Measurement Model Instrument Reliability and Validity

Constructs	Code	Item	Mean	Std. Dev.	Cronbach's Alpha >=0.8, Meritorious)
Performance Expectancy	**PE**	PE02	2.32	1.112	0.936
		PE06	2.18	1.160	0.935
		PE05	1.82	1.294	0.936
Effort Expectancy	**EE**	EE02	2.53	1.018	0.936
		EE03	2.63	1.071	0.937
		EE04	2.28	1.145	0.936
Social Influence	**SI**	SI11	1.66	1.350	0.936
		SI08	1.78	1.313	0.938
		SI12	1.78	1.360	0.936
Facilitating Conditions	**FC**	FC13	2.60	1.033	0.938
		FC12	2.72	1.015	0.938
		FC11	2.36	1.186	0.936
Hedonic Motivation	**HM**	HM03	2.18	1.219	0.936
		HM05	2.16	1.151	0.936
		HM06	2.10	1.288	0.935
Price	**PR**	PR03	2.37	1.150	0.936
		PR01	2.31	1.196	0.936
		PR04	2.34	1.203	0.935
Behaviour Intention	**BI**	BI01	2.51	1.047	0.936
		BI02	2.20	1.130	0.936
		BI03	2.51	1.063	0.935

This index shows how well a particular factor solution accounts for what all the variables together represent; in other words, the amount of variance represented by the information in the factor matrix (Hair et al., 2006). The index for this solution is high, indicating that the variables are in fact highly related to each other. Furthermore, all the items of the habit construct cross loaded heavily with other constructs. Hence all the items mentioned in Table 21 (Hypothesis set-I), except the three items of habit, will be used for conducting confirmatory factor analysis (CFA).

The final principal component factor analysis solution lead to seven constructs identical to the UTUAT2 model and this justifies using this model. All the seven factors were left with three items each after stringent criteria elimination. The reliabilities of these dimensions are in the excellent range (> 0.90) for each as shown in Table 46. The factor loadings of each item per construct also demonstrate prominent and distinct higher factor loadings than on other constructs, suggesting adequate convergent and discriminant validity (Hu et al., 1999). The techniques used to extract the best set of variables with high factor loading also prove high reliability and construct validity, thereby signifying the adequacy of the measuring tool.

5.9 Confirmatory Factor Analysis (CFA)

As stated earlier, after extracting the best set of factors from the PCA stage, the data will be analysed using confirmatory factor analysis. The CFA stage will assess the model's goodness of fit, reliability, validity and test the hypothesis. Similar to the steps adopted for extracting latent factors in PCA, conducting confirmatory factor analysis also illustrates comparable steps to assess model fit, model validation and testing of the research hypothesis.

Structural Equation Modelling or SEM, is a generic statistical modelling technique which involves variants of factor analysis, path analysis and multivariate regression analysis. The confirmatory aspect of a model is carried by confirmatory factor analysis (CFA), a multivariate regression procedure that is used to test how well the measured variables represent the number of constructs from the hypothesised commonality among latent variables. The principal aims and outcomes of confirmatory factor analysis (CFA) are discussed below.

1. See if factor models fit a new sample - the confirmatory aspect
2. Study the properties of individuals by examining factor variances, and covariances

3. To study factor variances that show heterogeneity in a population
4. To study factor correlations that show the strength of the association between factors
5. To study the behaviour of new measurement items embedded in a previously studied measurement instrument
6. Estimate factor scores
7. To re-investigate a Principal Component Analysis (PCA)
8. Study how well a hypothesized factor model fits a new sample population.

In a structural equation model, CFA technique hypothesises a set of parameters (factor loadings, correlations and uniqueness) and tests the model for its validity. Structural equation models are primarily divided into two - the measurement model and the structural model. The measurement model deals with the relationships between measured variables and latent variables. The structural model deals with the relationships between latent variables only. To achieve the above outcomes, a four step confirmatory factor analysis procedure was designed as shown in Figure 21.

1. Stage - One (CFA): Developing Measurement Model for Individual Constructs
2. Stage - Two (CFA): Assess the Structure Model Validity
3. Stage - Three (CFA): Develop Structure Model for Multivariate Regression
4. Stage - Four (CFA): Develop Path Models for Research Hypothesis Testing

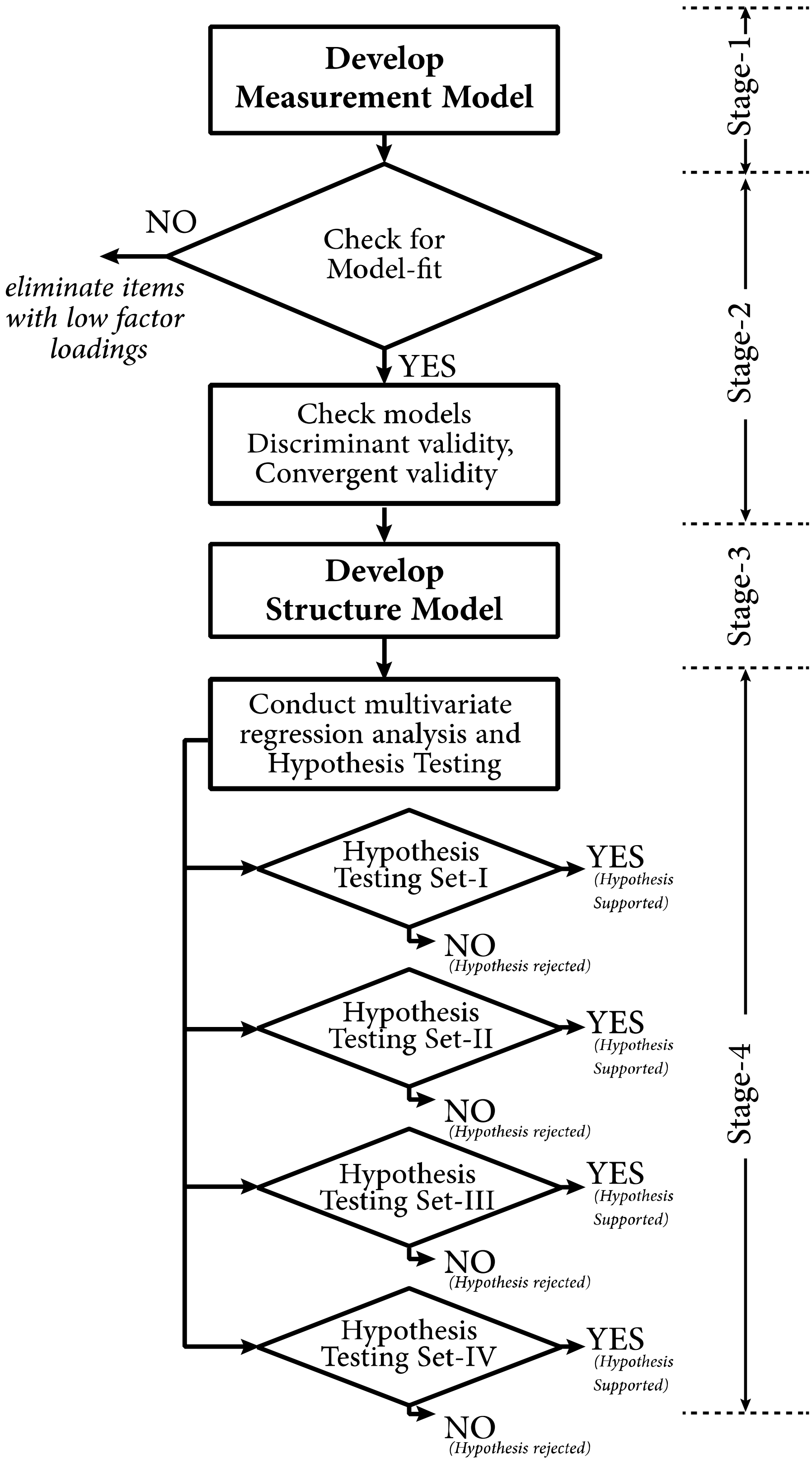

Figure 21: CFA Stages for Measurement and Structural Model

5.9.1 Stage - One (CFA):

Measurement Mode Stage-one focuses on defining the individual constructs of the theorised model and the relationships between the unobserved variable (latent) and the dependent variable. Furthermore, this step of confirmatory factor analysis (CFA) considers the concept of uni-dimensionality between construct error variances. The construction of the measurement model involves two steps:.

1. Model Specification
2. Model Estimation (Identification)

Model specification involves determining the parameters that are to be fixed or free. Fixed parameters are not estimated from the data, indicating no relationship between variables while free parameters are estimated from the observed data. When testing the fit of the model, the freeing and fixing of the parameters is done to compare the hypothesised model. The model adopted for this research was developed from UTUAT2 technology acceptance. The UTAUT2 model attempts to define the relationship of behaviour intention (dependent variable) in relation to the other seven independent constructs.

Model Identification dictates that each measure should load on only one construct and each construct has at least two or more indicators or items. In the SEM model identification procedure, causal variables (independent variables) are called exogenous variables and the effect variables are called endogenous variables (dependent variables). The earlier performed PCA provided a clear set of relationships, as theorised in the UTUAT2 model using IBM AMOS 22 software application. This is illustrated in Appendix G.

The oval shaped elements are latent variables (constructs) of the UTAUT2 model and the rectangles represent the best sets of item variables extracted during the PCA factor extraction process. The circular elements are the measurement errors which are the variability in the indicators not attributable to the latent variables.

5.9.2 Stage – Two: Assess the Measurement Model Fit and Validity

The second aim of CFA is to assess the measurement model validity. In this stage the theoretical measurement model is compared with the reality model to see how well the data fits. To check the measurement model fit, a number of indicators are used. The key indicators that help in measuring the model validity are Chi-square test (CMIN) and other goodness of fit indicators (Abu-Al-Aish & Love, 2013; Leong et al., 2013; Luan & Timothy, 2008).

CFA was conducted using AMOS 22 to assess the measurement model goodness of fit, and later to extract the imputed values of each construct for conducting multivariate regression analysis for hypothesis testing. The most common five model-fit measures used to assess the model's overall goodness of fit are: CMIN is the ratio of X^2 to degrees of freedom (df), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI) and root mean square residual (RMSR) and RMSEA (Jöreskog, 1993). Hair et al. (2006) suggest that if three or four indexes meet the required recommended value, this measurement model is recommended for further analysis.

Table 47: Fit Indices for Measurement Model

Goodness-of-Fit Measure	Recommended Value	Measurement Model	Result
CMIN: Chi-square to Degrees of Freedom (X^2/d.f.)	<= 3.0	1.980	Good Fit
CFI: Comparative Fit Index	>= 0.9	0.952	Good Fit
RMSEA: Root Mean Square of Error Approximation	<= 0.8	0.058	Good Fit
SRMR: Root Mean Square Residual	<= 0.09	0.059	Good Fit
GFI: Goodness of Fit Index	>= 0.9	0.906	Good Fit
AGFI: Adjusted Goodness of Fit Index	>= 0.8	0.870	Good Fit

As shown in Table 47 above, all of the model-fit indices exceeded their respective common acceptance levels suggested by previous research, thus demonstrating that the measurement model exhibited a good fit with the data collected. The next step of the fitness test will proceed to evaluate the psychometric properties of the measurement model in terms of convergent validity and discriminant validity.

Convergent validity ensures that a particular item is designed to measure the construct it is supposed to measure. Average variance extracted (AVE) and composite reliability (CR) were proposed by (Fornell & Bookstein, 1982) as measures to assess convergent validity. Of all the constructs, composite reliability exceeded the recommended level of 0.7 as illustrated in Table 48 (Hair Jr et al., 1986). An AVE of more than 0.50 implies 50% variance of its items, demonstrating adequate convergent validity. The final extracted results from convergent validity test indicate that all items fit their respective factors beyond the required threshold of AVE>0.5 and furthermore, all correlations were below the threshold value of 0.90 (Hair Jr et al., 1986).

Discriminant validity is described as the degree to which constructs differ from each other, and indicate that items do not unintentionally measure something else. Fornell and Bookstein (1982) posit that an item should not load more highly on the items belonging to other constructs. Discriminant validity is achieved if the square of the AVE (underlined in Table 48) is higher than correlation between constructs. However, during the initial factor extraction, indicators in the BI03 item of behaviour intention cross-loaded excessively with items of effort expectancy and hence was removed.

Table 48: Construct Correlation Matrix (Discriminant Validity)

Constructs	**CR>0.7**	**AVE>0.5**	**BI**	**PR**	**SI**	**HM**	**FC**	**EE**	**PE**
BI	0.744	0.592	0.770						
PR	0.891	0.732	0.612	0.855					
SI	0.826	0.616	0.590	0.552	0.785				
HM	0.856	0.665	0.672	0.624	0.658	0.816			
FC	0.755	0.506	0.688	0.577	0.584	0.634	0.712		
EE	0.800	0.570	<u>0.783</u>	0.626	0.625	0.598	0.708	0.755	
PE	0.803	0.576	0.760	0.700	0.722	0.728	0.632	0.731	0.760

Note: Diagonal values shows square root of AVE, the off-diagonal shows the correlations between construct

After considering the removal of the BI03 item, the discriminant validity of all the latent factors improved to acceptable levels. However, effort expectancy still shows some increased levels of correlation against behaviour intention.

However, it has been argued that this construct loses its influence on behaviour intention when users accumulate experience during their continued use (Hackbarth, Grover, & Mun, 2003). Farrell and Rudd (2009) suggest that, in the case of multi-sample population, the discriminant validity should be assessed independently to achieve a higher level of acceptable values.

5.9.3 Stage - Three (CFA): Developing a Structure Model

This section deals with developing a structure model which is a path diagram for all the causal relationships in accordance to the adopted UTAUT2 model theory. The resultant significant regression path coefficients from the structure model will be used to assess the hypotheses of this research. In the first stage, the first set (Set - I) of hypothesis will be confirmed by finding significant levels of path coefficients. The remaining three sets of hypotheses (Set - II, Set - III and Set - IV) will be carried out in the next three stages for hypothesis testing, using Z-score group comparison testing, which are discussed in detail in the conclusion and discussion chapter of this thesis.

The first set (Set - I) of hypotheses attempts to find the relevance of the UTAUT2 model and its significance in predicting the acceptance of the Smartphone as a mobile learning tool in a university context. The second set (Set - II) of hypotheses deals with finding the significance of the UTAUT2 moderators. As mentioned earlier, the three moderators theorised in this research, in order to assess the behaviour intention to use Smartphones for education, are contexts, gender and educational level,.

The third set (Set - III) of hypotheses analysed the effect of moderator’s context (CX1 and CX2), gender (Men and Women) and educational level (undergraduate and postgraduate) and compared them. The third set also contains the main findings of the study and is expected to contribute to the body of knowledge surrounding technology acceptance.

The fourth and the final (Set - IV) of hypotheses examine the intra moderation effect. This set of data analysis investigates each moderator and its moderating effect across the two context of the study.

5.9.4 Stage – Four: Develop Path Models for Research Hypothesis Testing

The final outcome of conducting CFA is to test the hypotheses from the commonalities embedded among the variables. CFA is a multivariate procedure, used to test multiple hypotheses that constitute a structural model (Beavers et al., 2013). Section 3 will discuss the multivariate regression analysis for the four sets of hypotheses (Sets I, II, II and IV) while section 4 will discuss testing the thesis' hypotheses.

5.10 Section 3: Structural Model Results:

This part deals with conducting multivariate regression on the structural model to examine hypothesised relationships. The resultant path coefficients from the structure model were analysed using the Statistical applications IBM SPSS and IBM AMOS. The section commences with multivariate regression path coefficients, and proceeds with each research hypothesis set individually.

5.10.1 Regression Analysis: Hypothesis Set - I

This study aims to investigate whether students from two contexts (the College of Engineering – CX1 and the College of Education - CX2) are open to using Smartphones in education. Thus, some modifications have been made to the UTAUT2 model to ensure a good fit.

5.10.1.1 Significance of UTAUT2 Constructs on the Total Population (CX1 + CX2)

This research uses the UTAUT2 model to assess the continuous intention of students to use Smartphones for education. The total number of hypotheses in set 1 are illustrated in Table 49. The seven adapted UTAUT2 model constructs, namely performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value and habit, are seen as significant predictors of behaviour intention to use technology in many research studies, as mentioned in the literature review chapter.

This section of the study investigates and tries to validate the significance of the UTAUT2 model constructs in finding the total variance explained in accepting Smartphones for education. As explained above, the two contexts of this study were chosen after hypothesising that student acceptance of the Smartphone as a technology for learning is higher in educational settings.

Table 49: Research Hypothesis Set – I; UTAUT2 Model Significance

UTAUT2 Significance			
Constructs			Hypothesis Results
BIN	←	PE	H1: Supported
BIN	←	EE	H2: Supported
BIN	←	SI	H3: Supported
BIN	←	FC	H4: Supported
BIN	←	HM	H5: Supported
BIN	←	PR	H6: Not Supported
BIN	←	HA	H7:Not Supported
*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*			

Figure 22 explains the scores from the structural model with the assessed path coefficients and their respective significant levels *P*, as overall results of the hypotheses. The context combined here in this study specifies the total population of the contexts (CX1: The College of Engineering and CX2: The College of Education).

The total population's (CX1+CX2) multivariate regression results show that the significant path coefficients that affected behavioural intention were effort expectancy (EE=0.468), performance expectancy (PE=0.329), hedonic motivation (HM=0.160) and facilitating conditions (FC=0.151), ranked according to their intensities. Social influence (SI=-0.145) displayed negative significance. The model displayed 86% (R^2 adjusted) of the total variances explained in behavioural intention for the total population. The results also show that all the constructs except price (PR) show significant determinants for using the Smartphone as a learning tool by the total population of the study.

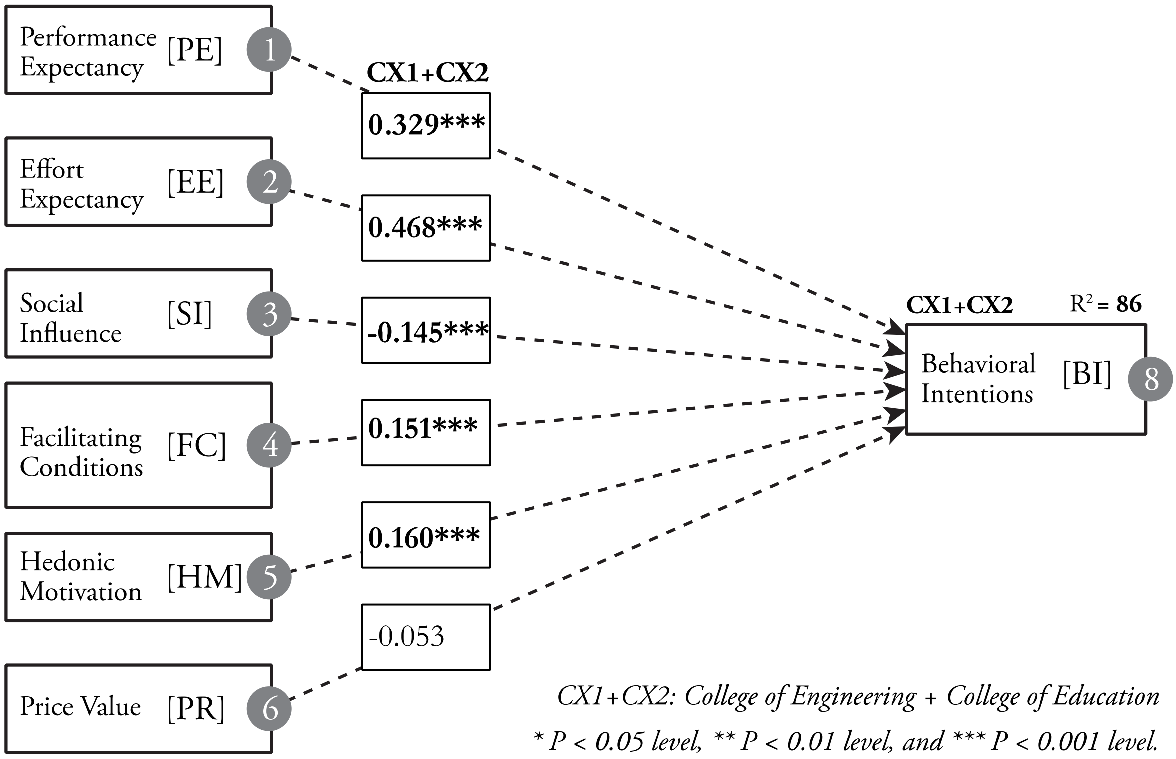

Figure 22: Regression Path Coefficients of Seven UTAUT2 Model Constructs

5.10.2 Regression Analysis: Hypothesis Set - II

The Effect of Moderators on the Total Population (CX1+CX2)

a. Gender CX1+CX2 (M:W)
b. Educational Level CX1+CX2 (UG:PG)

In this research, moderating roles of individual characters are also explored (gender and educational level) in relation to the independent and dependent variables as proposed in UTAUT2 against the second set of hypotheses (see Table 50).

The findings from this research are expected to expand the existing body of knowledge by determining whether the original UTAUT2 and moderators (gender and educational level) changed at the contextual level. These results would play a pivotal role in predicting the intention to use the Smartphone as a mobile learning device in a university setting.

Table 50: Research Hypotheses Set – II: Gender and Educational Level Moderation

Constructs			Gender	Educational Level
			M:W (CX1+CX2)	**UG:PG (CX1+CX2)**
BIN	←	**PE**	H8a	H8b
BIN	←	**EE**	H9a	H9b
BIN	←	**SI**	H10a	H10b
BIN	←	**FC**	H11a	H11b
BIN	←	**HM**	H12a	H12b
BIN	←	**PR**	H13a	H13b
BIN	←	**HA**	H14a	H14b

5.10.2.1 M(CX1+CX2) Gender Moderation on Total Population: Men

The significant path coefficients moderated by Men (CX1+CX2) on the total population of this study that affected behavioural intention were performance expectancy (PE=0.433), effort expectancy (EE=0.383), social influence (SI=-0.111), facilitating conditions (FC=0.301) and price (PR=-0.120), are shown in Table 51. The model displayed 87% (R^2 adjusted) of the total variances explained in behavioural intention for using Smartphones in education for the total population.

5.10.2.2 W(CX1+CX2) Gender Moderation on Total Population: Women

The significant path coefficients moderated by Women (CX1+CX2) on the total population of this study that affected behavioural intention were performance expectancy (PE=0.293), effort expectancy (EE=0.557), social influence (SI=-0.134) and hedonic motivation (HM=0.244). Notably, facilitating conditions and price did not show any significance as shown in Table 51. The model displayed 88% (R^2 adjusted) of the total variances explained in behavioural intention to use Smartphones for the total population. The common construct moderated by the gender (M:W) on the total population (CX1+CX2) of the study was effort expectancy (EE) only.

Table 51: Path Coefficients of Gender as a Moderator on Total Population

Constructs			Men (CX1+CX2)		Women (CX1+CX2)	
			Path Coefficient	*P*	Path Coefficient	*P*
BIN	←	PE	0.433	***	0.293	***
BIN	←	EE	0.383	***	0.557	***
BIN	←	SI	-0.111	**	-0.134	**
BIN	←	FC	0.301	***	0.007	NS
BIN	←	HM	0.087	NS	0.244	***
BIN	←	PR	-0.120	*	0.022	NS

5.10.2.3 UG(CX1+CX2) Educational Level Moderation on Total Population: UG

The significant path coefficients moderated by undergraduates (CX1+CX2) of the total population of this study that affected behavioural intention were performance expectancy (PE=0.376), effort expectancy (EE=0.469), social influence (SI=-0.129), facilitating conditions (FC=0.178) and hedonic motivation (HM=0.137) as shown in Table 52. The model displayed 77% (R^2 adjusted) of the total variances explained in behavioural intention to use Smartphones for the total population.

5.10.2.4 PG(CX1+CX2):Educational Level Moderation on Total Population

The significant path coefficients moderated by Women (CX1+CX2) on the total population of this study that affected behavioural intention were: performance expectancy (PE=0.383), effort expectancy (EE=0.469), social influence (SI=-0.129), facilitating conditions (FC=0.178) and hedonic motivation (HM=0.137). Price (PR) did not show any significance as shown in Table 52. The model displayed 83% (R^2 adjusted) of the total variances explained in behavioural intention to use Smartphones for the total population.

All of the constructs were moderated significantly by the level of education (UG:PG) on the total population (CX1+CX2) of the study except price.

Table 52: Path Coefficients on Educational Level as a Moderator on Total Population

Constructs			UG (CX1+CX2)		PG (CX1+CX2)	
			Path Coefficient	***P***	**Path Coefficient**	***P***
BIN	←	**PE**	**0.376**	***	**0.383**	***
BIN	←	**EE**	**0.469**	***	**0.457**	***
BIN	←	**SI**	**-0.129**	**	**-0.152**	***
BIN	←	**FC**	**0.178**	***	**0.109**	*
BIN	←	**HM**	**0.137**	***	**0.201**	***
BIN	←	**PR**	-0.067	NS	-0.010	NS

Additionally, the results from the gender and the educational moderation show that both of these moderators play a significant role in regulating the use of Smartphones as mobile learning tools; this proves the significance of all the constructs of the UTAUT2 model. The next stage of the study explores the effect of groups, comparing the regression weights of the contexts in total, followed by the effects of the two moderators and educational levels between the two contexts (CX1 and CX2).

5.10.3 Regression Analysis: Hypothesis Set - III

Inter Contextual Comparison: Effect of "Context," "Gender" and "Educational Level" between the Two Contexts (CX1:CX2)

The third set of hypotheses seeks to discover the effect of the two contexts, gender and educational level between the two contexts individually. The first set of regression weights will compare the significance of UTAUT2 constructs on the two contexts (CX1 and CX2), then it will assess the effect of combined gender on the two contexts. The effect of combined educational levels in the two contexts will also be assessed as illustrated in Table 53.

a. Context (CX1:CX2)
b. Gender CX1(M:W):CX2(M:W)
c. Educational Level CX1(UG:PG):CX2(UG:PG)

Table 53: Research Hypotheses Set – III: Inter Contextual Moderation

Constructs			**Context**	**Gender**		**Educational Level**	
			CX1:CX2	**M:W (CX1)**	**M:W (CX2)**	**UG:PG (CX1)**	**UG:PG (CX2)**
BIN	←	PE	H15a	H15b	H15c	H15d	H15e
BIN	←	EE	H16a	H16b	H16	H16d	H16e
BIN	←	SI	H17a	H17b	H17c	H17d	H17e
BIN	←	FC	H18a	H18b	H18c	H18d	H18e
BIN	←	HM	H19a	H19b	H19c	H19d	H19e
BIN	←	PR	H20a	H20b	H20c	H20d	H20e
BIN	←	HA	H21a	H21b	H21c	H121d	H21e

5.10.3.1 Context (CX1:CX2): Effect of Context as a Moderator

This study identifies important moderating factors that affect the use of Smartphones in education, as well as the parameters which influence their use. This thesis works on the premise that the use of Smartphones differs between contexts. This effect is hypothesised due to their intrinsic differences in curriculum, programme, schedule, mode of teaching, culture, learning content, student behaviour, aptitude, gender enrolment, assessment, faculty, infrastructure, support, teaching and learning methodology and pedagogy. This thesis does not intend to replicate the UTAUT2 model, rather it aims to examine whether the UTAUT2 model constructs influence Smartphone use in education.

Descriptive statistics from the questionnaire (Parts A, B and C) show that 98% of students use Smartphones. The evidence obtained from descriptive statistics also show that students currently use Smartphones for academic activities. This thesis aims to investigate the factors that affect Smartphone use for education. The detailed literature review demonstrates that UTAUT2 model constructs are some of the most accurate technology acceptance predictors in the field. As explained earlier, the third stage of this study assessed the inter contextual moderation of (context, gender and educational level) on behaviour intention to use Smartphone for education, focusing on six constructs of the UTUAT2 model.

5.10.3.2 CX1: College of Engineering Context

The path coefficients of this study, (see Figure 23), explain the scores from the structural model with the assessed path coefficients and their respective significant levels *P*.

In CX1, significant path coefficients that affected behavioural intention were performance expectancy (PE=0.328), effort expectancy (EE=0.424) and facilitating conditions (FC=0.315). Social influence (SI), hedonic motivation (HM) and price (PR) did not demonstrate significance. The model displayed 86% (R^2 adjusted) of the total variances explained in behavioural intention for CX1.

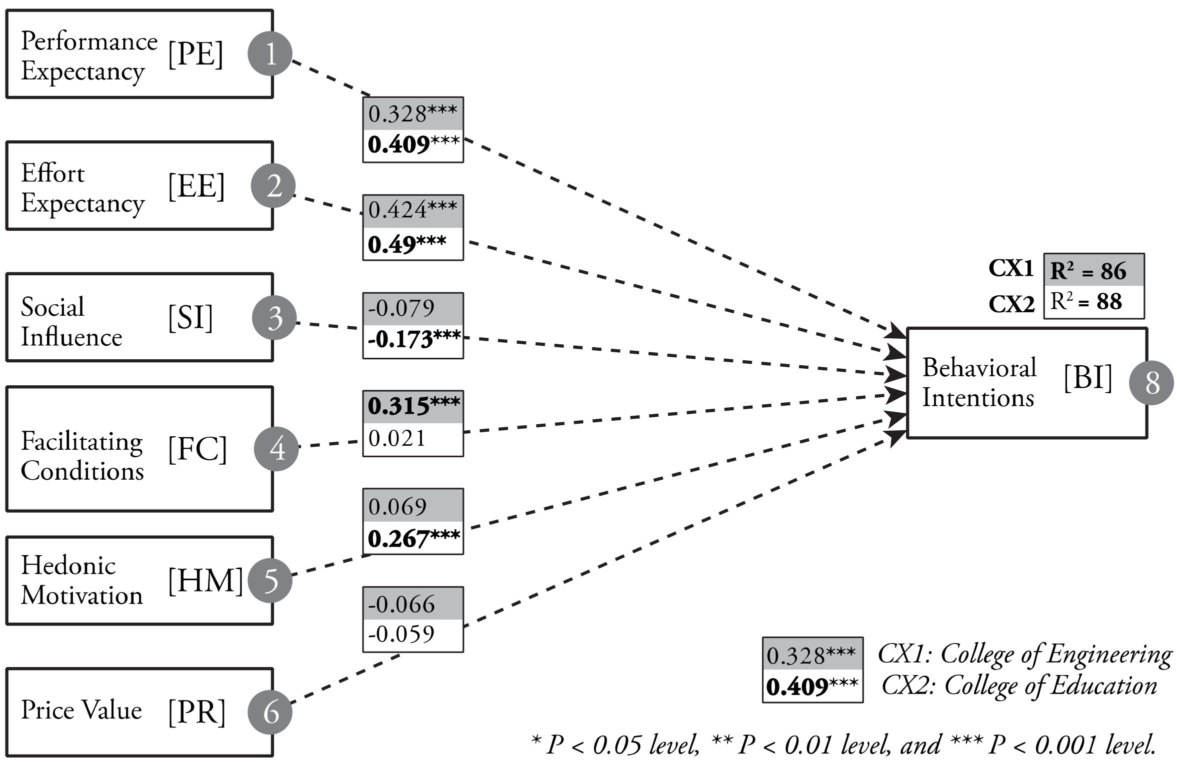

Figure 23: Regression Path Coefficients of CX1 and CX2

5.10.3.3 CX2: College of Education Context

In CX2, performance expectancy (PE=0.409), effort expectancy (EE=0.490), social influence (SI=-0.173), facilitating condition (FC=0.021) and hedonic motivation (HM=0.267) displayed significant effects on behavioural intention. Social Influence (SI) and hedonic motivation (HM) did not demonstrate any significance. The model displayed 88% of the variances (R^2 adjusted) in explaining the behavioural intention to use Smartphones for CX2 as shown in Figure 25. The common constructs, which show the intention to use Smartphones between the two contexts (CX1 and CX2) of the study, were performance expectancy (PE) and effort expectancy (EE).

5.10.3.4 CX1(M:W):CX2(M:W) Effect of Gender as a Moderator on CX1:CX2

This part of the regression analysis deals with analysing the data to check the inter moderation of gender between the two contexts. The inter moderation attempts to observe the effect of Men and Women in both the contexts individually and analyse their effects.

CX1(M): The significant path coefficients (ranked according to their intensities) that affected behavioural intention among Men in CX1 were, performance expectancy (PE=0.317), effort expectancy (EE=0.289), facilitating conditions (FC=0.465) and Price (PR=-0.103). For the CX1 Men, the research model presented 86% of the variance in behavioural intention (BI). Social influence (SI) and hedonic motivation (HM) did not show any significance (see Figure 24).

CX1(W): To examine the effect of BI with females as the gender moderator, we proceeded to inspect the effects of all the six constructs on behavioural intention. The results of the analyses are shown in Figure 8. The path coefficients which showed significance with Women in CX1 were performance expectancy (PE=0.373) and effort expectancy (EE=0.606). The variance showed for BI in CX1 was 95%. Social influence (SI), hedonic motivation (HM), facilitating conditions (FC), and price (PR) did not show any significance. The common constructs which show the intention to use Smartphones for CX1, moderated by gender, are performance expectancy (PE) and effort expectancy (EE).

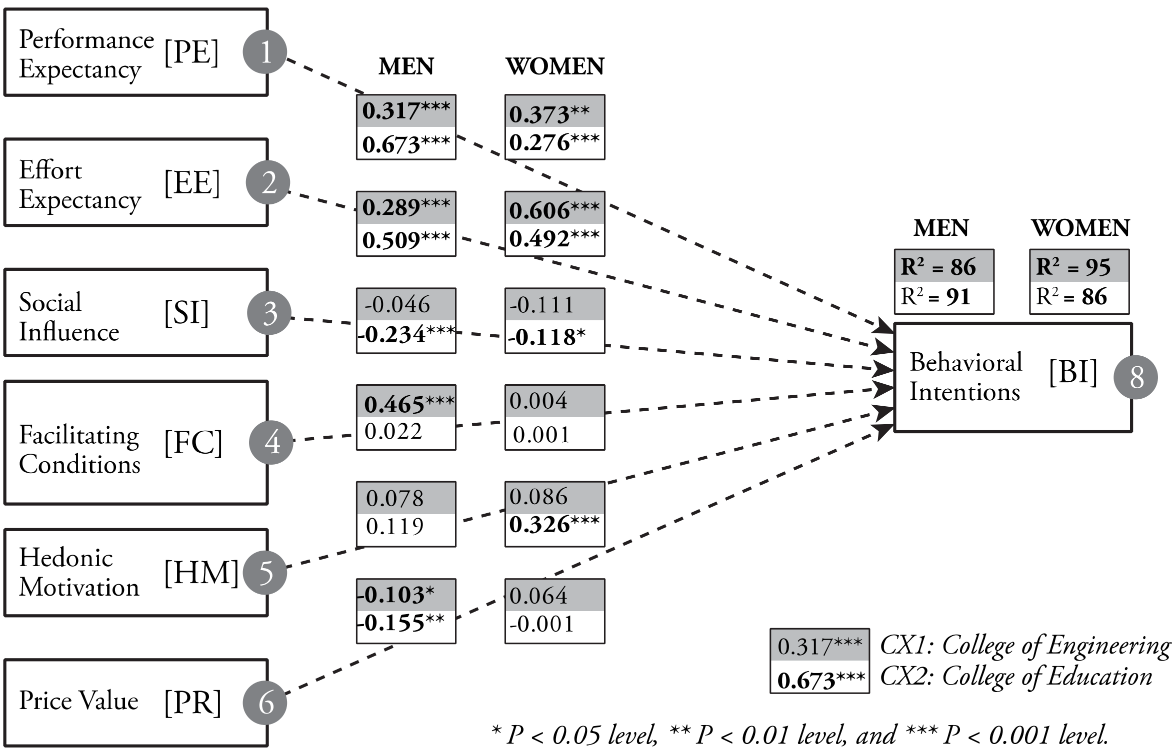

Figure 24: Regression Path Coefficients of CX1 and CX2 Moderated by Gender

CX2(M): In regards to CX2 Men, the path coefficients for performance expectancy (PE=0.673), effort expectancy (EE=0.509), social influence (SI=-0.234) and price (PR=-0.155) showed significant effects, and explained 91% of the variance in BI as indicated in Figure 26. Facilitating conditions (FC) and hedonic motivation (HM) did not show any significance.

CX2 (W): With regards to the CX2 Women, the path coefficients that showed significant positive effect on BI were performance expectancy (PE=0.276), effort expectancy (EE=0.492), social influence (SI=-0.118) and hedonic motivation (HM=0.326). The model explained 86% of the total variance presented for BI in CX2 as illustrated in Figure 26. Facilitating conditions (FC) and price (PR) did not show any significance.

As seen in Figure 26, the number of significant constructs of UTAUT2 and their respective intensities between Men and Women varied distinctly. For CX2 Men and Women, performance expectancy (PE) and effort expectancy (EE) were the most significant constructs.

5.10.3.5 Gender Bias in CX1 and CX2

There are more Men than Women in CX1 (Men 77% and Women 23%) and more Women than Men in CX2 (Men 33% and Women 67%) [see Table 25, results chapter 4]. This population sample reflects the current gender ratio of student enrolment in these two contexts. This could be taken as gender bias, or suggest that the large presence of Women in CX2 influenced an overall CX2 inclination towards the acceptance of Smartphones in education. Gender was studied as a principal moderator in all of the research incorporating the UTAUT2 model (Alrawashdeh et al., 2012; Pahnila et al., 2011; Venkatesh et al., 2012; Xu, 2014; Yang, 2013).

This thesis investigated this bias and concluded that even though there were more Men in CX1 than Women, two highly significant constructs for Women, namely PE and EE, showed higher significant coefficients than Men. Consequently, a similar scenario was evident among the Men population of CX2 demonstrating four significant constructs; PE, EE, SI and PR. Only one construct for Women, namely HM, showed significant behavioural intention to use Smartphones for education (see Figure 6.0). Gender as a bias in the data sample was ruled out as a result of these findings.

5.10.3.6 CX1(UG:PG):CX2(UG:PG) Effect of Educational Level as a Moderator

The significant path coefficients among CX1 undergraduates were performance expectancy (PE=0.325), effort expectancy (EE=0.438) and facilitating conditions (FC=0.309). The model displayed 77% (R^2 adjusted) of variances in explaining the behavioural intention to use the Smartphone for CX1 undergraduates, as shown in Figure 27.

The data analysis shows that among CX1 postgraduates (Master or PhD degrees), performance expectancy (PE=0.296), effort expectancy (EE=0.261), facilitating conditions (FC=0.414), and hedonic motivation (HM=0.189) presented significant positive effects on behavioural intention to use Smartphones as learning tools. The model displayed 92% (R^2 adjusted) of the variances in explaining behavioural intention to use Smartphones by CX1 postgraduate students (see Figure 25).

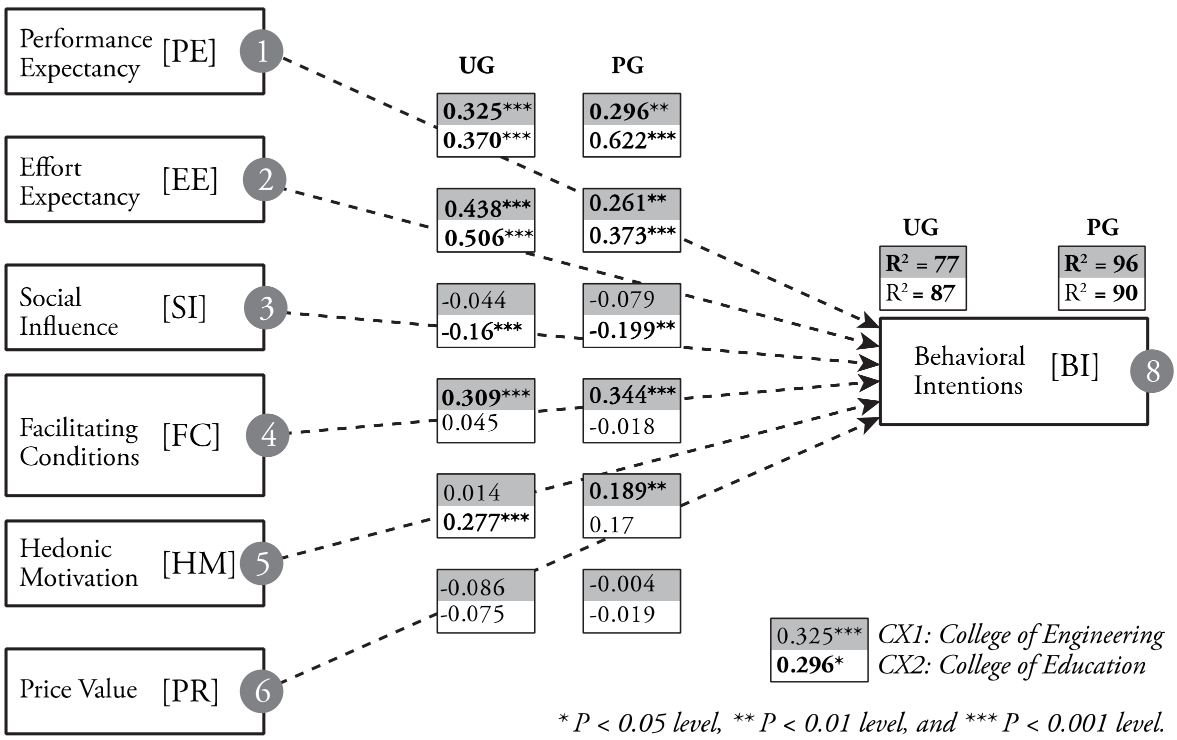

Figure 25: Path coefficients Moderated by Educational Level on CX1 and CX2

The relative comparison between the two educational levels (UG:PG) of CX1 shows that performance expectancy, effort expectancy and facilitating conditions presented the most common significant positive effects on behavioural intention to use Smartphones as learning tools.

The path coefficients of CX2 undergraduates showed the highest significant effect of behavioural intention, with performance expectancy (PE=0.370), effort expectancy (EE=0.506) and hedonic motivation (HM=0.277). Social influence (SI=-0.160) displayed a *negative* path coefficient. The model displayed 87% (R^2 adjusted) of the variances in explaining behavioural intention to use Smartphones by CX1 undergraduate students.

In terms of CX2 postgraduate students, the significant path coefficients were performance expectancy (PE=0.622), effort expectancy (EE=0.506) and social influence (SI=-0.199) (see Figure 9). Social influence also exhibited significant negative path coefficients. The model displayed 90% of the total variances explained in behavioural intention.

Comparison between the undergraduate and postgraduate students of CX2 reveal that performance expectancy, effort expectancy and social influence proved significant predictors of using Smartphones for learning. However, social influence demonstrated negative effects on behaviour intention (BI) as a dependent variable.

5.10.4 Regression Analysis: Hypotheses Set - IV

Intra Contextual Comparison: Effect of Men, Women, UG and PG between the Two Contexts (CX1 and CX2) (see Table 54 hypothesis sets)

1. Gender CX1(M):CX2(M)
2. Gender CX1(W):CX2(W)
3. Educational Level CX1(UG):CX2(UG)
4. Educational Level CX1(PG):CX2(PG)

Table 54: Research Hypotheses Set – IV: Intra Contextual Moderation

Constructs			**Gender**		**Educational Level**	
			CX1(M): CX2(M)	**CX1(W): CX2(W)**	**CX1(UG): CX2(UG)**	**CX1(PG): CX2(PG)**
BIN	←	**PE**	H22a	H22b	H22c	H22d
BIN	←	**EE**	H23a	H23b	H23c	H23d
BIN	←	**SI**	H24a	H24b	H24c	H24d
BIN	←	**FC**	H25a	H25b	H25c	H25d
BIN	←	**HM**	H26a	H26b	H26c	H26d
BIN	←	**PR**	H27a	H27b	H27c	H27d
BIN	←	**HA**	H28a	H28b	H28c	H28d

Regression analysis was used to examine the intra moderator effect between the two contexts of this study. At first, regression coefficients of CX1 Men were compared with CX2 Men. Regression coefficients of gender, CX1 Women were compared with CX2 Women. Accordingly for the second moderator, educational level, CX1 undergraduate students were compared with CX2 undergraduates. CX1 postgraduate regression values were compared with CX2. Table 25 shows the overall illustration of hypotheses. Table 24 and 25 explain the scores from the structural model with the assessed path coefficients and their respective significant levels *P*.

5.10.4.1 Effect of Gender on CX1 and CX2: Men

For CX1 Men, the research model presented 86% variance in behavioural intention, and the path coefficients which showed significant positive effects for CX1 are performance expectancy (PE=0.317), effort expectancy (EE=0.289), facilitating conditions (FC=0.465), and price (PR=-0.103) (see Table 55).

Table 55: Path Coefficients Moderated by Men on CX1 and CX2

Constructs			CX1-Men		CX2-Men	
			Path Coefficient	***P***	**Path Coefficient**	***P***
BIN	←	**PE**	**0.317**	***	**0.673**	***
BIN	←	**EE**	**0.289**	***	**0.509**	***
BIN	←	**SI**	-0.046	NS	**-0.234**	***
BIN	←	**FC**	**0.465**	***	0.022	NS
BIN	←	**HM**	0.078	NS	0.119	NS
BIN	←	**PR**	**-0.103**	*	**-0.155**	**

The path coefficients for performance expectancy (PE=0.673), effort expectancy (EE=0.507), social influence (SI=-0.234), and price (PR=-0.155) showed significant positive effect in Men CX2, demonstrating 91% of the variance in behavioural intention as seen in Table 55. For CX2, the path coefficients for PR–BI and HD–BI were 0.16 and 0.55 respectively. Performance expectancy and effort expectancy (EE=0.490) were common contributing influences for accepting Smartphones, while price (PR) showed a negative influence.

5.10.4.2 Effect of Gender on CX1 and CX2: Women

To examine the effect of Women as a gender influence, we proceeded to inspect the effects of all of the six constructs on behavioural intention. The results of the analyses are shown in Table 56. The path coefficients which showed significance with Women in CX1 include performance expectancy (PE=0.373) and effort expectancy (EE=0.606). The model showed 95% of the variance in behavioural intention.

Table 56: Path Coefficients Moderated by Women in CX1 and CX2

Constructs			CX1-Women		CX2-Women	
			Path Coefficient	*P*	Path Coefficient	*P*
BIN	←	PE	**0.373**	***	**0.276**	***
BIN	←	EE	**0.606**	***	**0.492**	***
BIN	←	SI	-0.111	NS	**-0.118**	*
BIN	←	FC	0.004	NS	0.001	NS
BIN	←	HM	0.086	NS	**0.326**	***
BIN	←	PR	0.064	NS	-0.001	NS

The College of Education context was examined against the effect of Women as a gender influence on behavioural intention. The path coefficients which showed significance with CX1 Women include performance expectancy (PE=0.276), effort expectancy (EE=0.492) and social influence (SI=-0.118) (see Table 28). The model showed 86% of the variance in behaviour intention. Performance expectancy (PE) and effort expectancy (EE) were the most common contributing influences in accepting Smartphones, while price (PR) showed a significant negative influence, as seen in the above Table 56.

5.10.4.3 Effect of Same Education Level on CX1 and CX2: Undergraduates

The comparison shows that among CX1 undergraduate students, performance expectancy (BI-PE, 0.325), effort expectancy (BI-EE, 0.438) and facilitating conditions (BI-FC, 0.309) presented significant positive effects on behaviour intention to use Smartphones as learning tools (see Table 57). The model displayed 92% (R2 adjusted) of variances in explaining behaviour intention to use the Smartphone for UGs in CX1.

CX2 undergraduates showed significant positive effects in relation to performance expectancy (BI-PE, 0.370), effort expectancy (BI-EE, 0.506), facilitating conditions (BI-FC, -0.160) and hedonic motivation (BI-HM, 0.277) on BI (see Table 57). The model displayed 91% (R2 adjusted) of the total variances explained in behavioural intention.

Table 57: Path Coefficients Moderated by Undergraduates (UG) of CX1 and CX2

Constructs			CX1-UG		CX2-UG	
			Path Coefficient	***P***	**Path Coefficient**	***P***
BIN	←	**PE**	**0.325**	***	**0.370**	***
BIN	←	**EE**	**0.438**	***	**0.506**	***
BIN	←	**SI**	-0.044	NS	**-0.160**	***
BIN	←	**FC**	**0.309**	***	0.045	NS
BIN	←	**HM**	0.014	NS	**0.277**	***
BIN	←	**PR**	-0.086	NS	-0.075	NS

5.10.4.4 Effect of Same Education Level on CX1 and CX2: Postgraduates

The data analysis shows that among the CX1 students who were pursuing their postgraduate degrees, performance expectancy (BI-PE, 0.296), effort expectancy (BI-EE, 0.261), facilitative conditions (BI-FC, 0.344) and hedonic motivation (BI-HD, 0.189) presented significant positive effect on behavioural intention to use Smartphones as learning tools. The model displayed 93% (R2 adjusted) of the variances in explaining the behavioural intention to use Smartphones by PG students in CX1 as seen in Table 58.

Table 58: Path Coefficients Moderated by Undergraduates (UG) of CX1 and CX2

Constructs			**CX1-PG**		**CX2-PG**	
			Path Coefficient	***P***	**Path Coefficient**	***P***
BIN	←	**PE**	**0.296**	**	**0.622**	***
BIN	←	**EE**	**0.261**	**	**0.373**	***
BIN	←	**SI**	-0.079	NS	**-0.199**	**
BIN	←	**FC**	**0.344**	***	-0.018	NS
BIN	←	**HM**	**0.189**	**	0.170	NS
BIN	←	**PR**	-0.004	NS	-0.019	NS

CX2 postgraduate students showed significant positive effects of performance expectancy (BI-PE, 0.622), effort expectancy (BI-EE, 0.373) and facilitating conditions (BI-FC, -0.199) on BI and the model displayed 95% (R2 adjusted) of the total variances explained in behavioural intention as illustrated in Table 58.

The next chapter will discuss the outcome of results in relation to all the four sets of hypotheses of this research in detail. The next chapters will also conclude the results of the hypotheses with interpretations and by comparing and contrasting each group of hypotheses.

Chapter 6

6.0 Discussion of Hypothesis

6.1 Introduction

This chapter concentrates on discussing the outcomes related to the four sets of hypotheses formulated for this research. Each set of hypotheses is concluded individually with its underlying discussion and supported by literature review. This chapter starts by briefly reviewing the research questions as well as the construction of the four sets of hypotheses that drive this study. Furthermore, each of the hypothesis' path coefficients, statistical significances and group differences are further speculated, interpreted and discussed within the realm of this research.

6.1.1 Research objectives

This research had three main objectives, as outlined below:

1. predict the viability of the UTAUT2 in explaining Smartphone technology acceptance behaviour in a New Zealand University
2. extend the UTAUT2 to assess the effects of context, gender and educational level as moderators of the study
3. examine the deeper role of context through Inter and Intra moderator comparisons

In order to answer the research objective, the researcher applied a strategy by investigating the applicability of two contextual group comparisons for the two academically different contexts (CX1 and CX2).

As previously noted, 311 undergraduate and postgraduate students were surveyed for this study. They were all enrolled in the university in 2014 in undergraduate and postgraduate programs. One of the main aim of this study was to confirm the ability of the unified theory of acceptance and use of technology (UTAUT2) model to determine a user's acceptance of a specific technology. The other core aim was to use the UTAUT2 model and modify it for this study, by using context and educational level as moderators. The data was analysed to determine descriptive statistics and statistical validity, with IBM SPSS 22 and IBM AMOS 22, in order to understand the participants' perceptions and behavioural intent with regards to the use of the Smartphone as a learning tool. The data produced by the statistical analysis provides a basis for responding to the individual research hypotheses. To assess the significance of group differences within the two contextual populations, this study used the Z scores group comparison technique.

6.2 Summary of Hypothesis

In order to answer the above research questions, the research methodology translated them into four sets of hypotheses as mentioned below

1. **Set I: "UTAUT2" Constructs Significance on Total Population (CX1+CX2)**
2. **Set II: Effect of Moderators on Total Population (CX1+CX2)**
    a. Gender CX1+CX2 (M:W)
    b. Educational Level CX1+CX2 (UG:PG)
3. **Set III: <u>Inter</u> Moderation Effect of Contexts across the two groups**
    a. Context (CX1:CX2)
    b. Gender CX1(M:W):CX2(M:W)
    c. Educational Level CX1(UG:PG):CX2(UG:PG)
4. **Set IV: <u>Intra</u> Moderation Effect of Contexts within the two groups**
    a. Gender
        i. CX1(M):CX2(M)
        ii. CX1(W):CX2(W)
    b. Educational Level
        iii. CX1(UG):CX2(UG)
        iv. CX1(PG):CX2(PG)

6.2.1 Set-I Hypothesis: Significance of UTAUT2 Constructs on Context Combined:

The first set of hypotheses attempts to establish the significance of the seven UTUAT2 constructs on Behaviour Intention (BI) to accept Smartphones as mobile learning tools.

1. Performance Expectancy (BI ← PE)
2. Effort Expectancy (BI ← EE)
3. Social Influence (BI ← SI)
4. Facilitating Conditions (BI ← FC)
5. Hedonic Motivation (BI ← HM)
6. Price Value (BI ← PV)
7. Habit (HB) (BI ← HA)

In order to assess the significance of the UTAUT2 model and its constructs and relevance, this research evaluated the path coefficients for the combined population sample (CX1+CX2) as illustrated above. The path coefficients of the combined contextual population (CX1+CX2), Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Hedonic Motivation, all proved significant predictors of using Smartphones as mobile learning tools (as displayed in Table 59). Social influence (SI), however, demonstrated significant negative predictors thus indicating that the behaviour intention to use Smartphones was inversely effected by SI. Meanwhile, Price (PR) displayed a negative influence but did not confirm its significance.

Table 59: UTAUT2 Model Constructs Path Coefficients

UTAUT2 Significance					
Constructs			**CX1+CX2**		**Hypothesis Results**
			Path Coefficient	*P*	
BIN	←	**PE**	**0.379**	***	**H1: Supported**
BIN	←	**EE**	**0.468**	***	**H2: Supported**
BIN	←	**SI**	**-0.145**	***	**H3: Supported**
BIN	←	**FC**	**0.151**	***	**H4: Supported**
BIN	←	**HM**	**0.160**	***	**H5: Supported**
BIN	←	**PR**	-0.053	NS	H6: Not Supported
BIN	←	**HA**	NA	NA	H7: Not Supported

*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*

As outlined in the results chapter, all the items of habit (HA) did not load as a single factor during the principal component factor analysis, hence this construct will be considered insignificant to investigate the hypothesis of this research.

The results indicate that performance expectancy and effort expectancy emerged as the two strongest predictors of behavioural intention to use m-learning using Smartphones, followed by the next equally strong path coefficients of social influence, facilitating conditions and hedonic motivation .

H1, *H2*, H3, *H4* and *H5* supported the hypotheses of this study while *H6* and *H7* did not. These results substantiate the relevance of the UTAUT2 model in predicting behaviour intention of technology acceptance. Furthermore, the path coefficients demonstrated 86% (R^2 adjusted) of the total variance explained in behavioural intention to use Smartphones by the total population of this study. The relationship between each of the seven constructs of UTAUT2 and the behavioural intention towards using the Smartphone as a mobile learning device, is discussed in length below.

6.2.1.2 The Effect of Performance Expectancy on Behaviour Intention (BI ← PE)

Performance expectancy is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al., 2003). The literature suggests that the perceived usefulness of mobile learning significantly affects users' attitudes, thereby influencing their behavioural intention towards using them (Carlsson, Carlsson, Hyvonen, Puhakainen, & Walden, 2006; Wang et al., 2009). They argue that Performance expectancy is the strongest predictor of the behavioural intention to use mobile learning.

Many other studies have also confirmed the significance of Performance expectancy as a construct (Chang, Ng, Sim, Yap, & Yin, 2015; Oechslein et al., 2014; Raman & Don, 2013; Venkatesh et al., 2012; Wang et al., 2009; Xu, 2014). All of these studies, including this thesis, suggest that Smartphone users perceive an improvement in their performances. Additionally, this thesis found that students prefer Smartphones to be incorporated in university-based learning contexts.

The results obtained from the present study show that performance expectancy is one of the strongest and most positive predictors of acceptance. The findings for performance expectancy were anticipated; earlier research conducted by Wang et al. (2009) and UTAUT research conducted by (Venkatesh et al., 2003), predicted similar results. The survey items for performance expectancy address usefulness in learning, productivity, time spent on learning activities, and grades.

The results from the two studies mentioned above suggest that perceived usefulness is essential to a user's acceptance and intention to use mobile devices for learning. This results were consistent with previous research listed in Table 2 (Abdulwahab & Zulkhairi, 2012; Alalwan, Dwivedi, & Williams, 2013; Alrawashdeh et al., 2012; Carlsson et al., 2006; Chang et al., 2015; Estorninho, 2014; Hackbarth et al., 2003; Harsono & Suryana, 2014; Oechslein et al., 2014; Raman & Don, 2013; Segura & Thiesse, 2015; Wang et al., 2009; Wilson et al., 2010; Wu et al., 2008; Xu, 2014; Yang, 2013; Yee, 2015; Yu, 2012; Zhang, Huang, & Chen, 2010). The more students recognize mobile learning as useful in their learning and as a promoter of productivity, the more likely they are to engage in mobile learning.

The survey used in this research focused on three factors, outlined below:

1. Using my Smartphone will help me accomplish my learning more quickly
2. Using my Smartphone will help me get better grades in my education
3. Using my Smartphone for my University education increases my productivity

Speculations can be drawn that the three items clearly reflect the students' strong belief that using a Smartphone would improve their grades, help them learn faster and improve their productivity. Universities thus need to focus their resources in the areas that most influence the acceptance o(Woodcock, Middleton, & Nortcliffe, 2012)f mobile learning in order to help students achieve better grades. Encouraging the use of technologies, such as Smartphones, will enable universities to achieve educational success.

Alternatively it can also be inferred that the best predictors of Smartphone acceptance are student readiness and commitment to use this particular technology. Taking cues from the students' response on using Smartphones to improve academic performance, it is important for universities to cultivate positive user attitudes that align with the institution's values, as well as to facilitate its use and acceptance behaviours in the classroom.

6.2.1.3 The Effect of Effort Expectancy on Behaviour Intention (BI ← EE)

Effort expectancy is defined as the degree of ease an individual associates with the use of an information system or technology. In this thesis, EE refers to the extent to which students consider the use of Smartphones easy and intuitive (Murgraff, McDermott, & Walsh, 2003; Venkatesh et al., 2012). However, with continued and prolonged use of technology, it is suggested that this construct becomes less important (Hackbarth et al., 2003).

The results from the path analysis of the first set of hypotheses revealed that EE positively influences BI in adopting mobile applications; these results are consistent with previous research findings (Teo, Lim, & Lai, 1999; Wong, Wei-Han Tan, Loke, & Ooi, 2014). The findings of this thesis suggest that an individual with high effort expectancy is more likely to accept Smartphones in educational institutions than an individual with lower performance expectancy. The findings of this thesis are analogous to the previous research conducted in similar fields, as listed in Table 2 (Alalwan et al., 2013; Alrawashdeh et al., 2012; Carlsson et al., 2006; Chang et al., 2015; Estorninho, 2014; Hackbarth et al., 2003; Harsono & Suryana, 2014; Oechslein et al., 2014; Raman & Don, 2013; Segura & Thiesse, 2015; Venkatesh et al., 2012; Wilson et al., 2010).

It can be contemplated that the users believe that Smartphones are understandable, easy to operate and that they can become skilful at using them. It follows that when users find Smartphones easy to use they are more likely to use them for educational and learning-related activities. Alternately, if using Smartphones required great effort, users would be discouraged from adopting the device for education. Effort Expectancy was found to be highly significant within this study and could indicate that the creation of easy-to-use and intuitive systems might bolster the actual usage of Smartphones. H2 is supported here may be because the adoption intention is nurtured by the users' perception of how easy mobile applications are to use.

Ease of use was determined using three questions at the elimination stage:

1. I find my Smartphone easy to use for my education;
2. It is easy for me to become skilful at using my Smartphone for my education
3. Using my Smartphone for my education is effortless

Students reported that Smartphones were easy to use and required little effort. The integration of the Smartphone as a mobile learning tool could benefit students since most students have been using the device for very extensively (Woodcock et al., 2012). Students already use Smartphones for communication, computing, personal assistance, gaming and accessing information or learning content through the internet. Hence it can be inferred that effort expectancy is a positive determinant of the behavioural intention towards accepting Smartphones for educational activities.

6.2.1.4 The Effect of Social Influence on Behaviour Intention (BI ← EE)

Social influence is the degree to which a student perceives that other individuals (i.e., peers, classmates and faculty) believe they should use Smartphones for learning (Venkatesh et al., 2003). The social influence construct resembles other constructs in the aggregated models comprising the UTAUT model, such as subjective norms in TRA, TAM2, TPB/DTPB, and combined TAM-TPB. These models and their terms are discussed in the hypothesis chapter of this research in length

Social norms are a determinant of perceived use in TAM2 and relate to an individual's intention to use a system ultimately through perceived usefulness. The effect of social norms on perceived usage tends to diminish under voluntary usage conditions (Venkatesh et al., 2003). This means that students follow their own belief systems rather than others' directives or they may rely upon their own experience with a system to form their intentions or perceptions of usefulness (Venkatesh & Davis, 2000). In another study, Venkatesh and Davis (2000) posit similar effects: the influence of social norms tends to diminish over time. Taylor and Todd (1995) reported that the relative influence of subjective norms on behavioural intention is observed to be stronger with novice users with no previous experience. In a similar study conducted by Karahanna, Straub, and

Chervany (1999) it was found that inexperienced users under the influence of social norms are often found to be more influenced than current experienced users.

This thesis differs with previous studies which argue that social influence has a positive relationship with behaviour intention (Alwahaishi & Snásel, 2013; Jaradat & Al Rababaa, 2013; Tsu Wei, Marthandan, Yee-Loong Chong, Ooi, & Arumugam, 2009). The study which assessed the acceptance of mobile e-Books among undergraduate students of a university found that there was a negative relationship between behaviour intention and social influence.

Studies conducted in the domain of mobile learning have reported social influence as a significant predictor of mobile learning (Carlsson et al., 2006; Kleijnen, Wetzels, & de Ruyter, 2004; Wang et al., 2009). When studying the relationship between social influence and intention to employ mobile devices using the UTAUT model, Carlsson et al. (2006) stress that the effects on behaviour intention are minimal. This study also suggests that social influence had a significant, negative and undeveloped effect on behaviour intention. According to Carlsson et al. (2006), social influence remained marginally significant with the inclusion of effort expectancy, facilitating conditions and service anxiety as other predictors for the use of new mobile devices and services. AlAwadhi and Morris (2008) concluded that social influence is expected to be significant in situations where the students are unacquainted with the use of technology.

Therefore a conjuncture can be drawn that the current study findings found that undergraduate students are not influenced by their peers, friends or faculty in their intention to use Smartphones for education. This was suggested by the negative high path coefficients of social influence. Sharples, Taylor, and Vavoula (2010) posit that modern students are more likely to make independent decisions without being influenced by people surrounding them; that is, family members, friends or lecturers. The supposition is that the participants of this study do not consider the opinions of peers or university teaching staff as important in their personal behaviour intentions to adopt Smartphones for education. According to San Martín and Herrero (2012), performance expectancy and effort expectancy are more important than social influence in the context of digital technology-related acceptance.

Fuksa (2013) found that social influence was insignificant, since the use of mobile technology has its own indispensable utilitarian influence and society plays a marginal role in influencing the user's intention to adopt a specific technology. Likewise, San Martín and Herrero (2012), reported in their study on the purchasing practices of online users, that social influence plays an insignificant role in relation to behaviour intention.

When it comes to the three main constructs of the UTAUT1 model, performance expectancy, effort expectancy and social influence, Jairak et al. (2009) posit that social influence is the weakest predictor. The researcher reflects in this thesis that the students are not influenced by others who think they should use m-learning. In his study of student use of mobile devices in education, AlAwadhi and Morris (2008) also found that social influence was the weakest variable among the postgraduate students. They concluded that this might be due to the adequate experience of their chosen professions that enabled them to think independently, as well as the relative insignificance of others' opinions. Gunawardana and Ekanayaka (2009), concluded that social influence was the weakest variable compared to the three indicators, performance expectancy, perceived usefulness and effort expectancy in UTAUT constructs. It can be concluded that when it comes to digital technologies like mobile devices and Smartphones, the user's social environment plays a minor role towards its usage.

After the variable extraction stage, the following items were retained; teaching faculty, friends and peers.

1. The University teaching staff are supportive of the use of my Smartphone for my education
2. Peers in my University prefer that I use my Smartphone for my education
3. My University friends encourage me to use my Smartphone for my education

The significance of social influence in this thesis (-0.145) may indicate that social influence has a negative impact on behavioural intention to use the Smartphone as a mobile learning device. Encouragement of mobile learning by peers and faculty can augment its usefulness, ease of use, and can positively affect an individual's intention to use mobile learning. In the university where this research was conducted there was no mobile learning initiative. According to the university's Academic Skills Centre (where this research was conducted), there are no formal mobile learning resources integrated into the university's online Moodle Learning Management Systems. The current E-learning provisions only work on desktop and laptop computers. The resulting negative path coefficients may also indicate the absence of any social encouragement or backing from the faculty or peers for students wanting to use Smartphones as learning tools. The three items of the social influence construct as mentioned above (faculty, peers and friends) were included to assess their effect upon Smartphone usage for educational purposes. A more profound positive effect or negative effect can be better assessed when the students use their mobile devices for education in a well-defined mobile learning environment. This research supposes that, in the absence of such a scenario, the student response simply reflects the absence of any social influence to use Smartphones as mobile learning tools.

6.2.1.5 The Effect of Facilitating Conditions on Behaviour Intention (BI ← FC)

Facilitating conditions are defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh et al., 2003). However, this thesis identifies communication and being connected with peers as a main driving force behind providing a facilitating condition. According to Sharples et al. (2010) conversation is the dynamic process towards learning. Facilitating conditions include the available individual resources and knowledge, and availability of assistance.

It can be assumed that, facilitating conditions do significantly affect behaviour intention to use Smartphones in the population surveyed in this thesis. The findings are in concurrence with the conclusions of UTAUT and the mobile learning literature; facilitating conditions and the perception of available support significantly affect users' behavioural intention to use mobile learning (Cheong et al., 2004; Venkatesh et al., 2003; Wu et al., 2007). The perception of this research is that students feel secure in taking additional help anywhere and anytime through the use of Smartphones. However, simply assuring the availability of resource does not ensure its use. Students should be informed of the strengths of creating a network of learners who can support various activities, including access to IT resources, seeking information, improving productivity, and other academic endeavours.

Previous research on technology acceptance suggests that providing resources and information to users on time has a significant positive effect on behavioural intentions to use mobile learning (Concannon, Flynn, & Campbell, 2005; Futurelab, Naismith, Lonsdale, Vavoula, Sharples, & Series, 2004). As stated earlier, the university where this research was conducted does not have a proper defined mobile learning program, infrastructure or learning content resource. It is perceived that in the absence of basic infrastructure or an organizational context for the adoption of new technology, Van Biljon (2006) argues that facilitating conditions become an important construct.

The three questionnaire items which were grouped together during the factor extraction step for the facilitating conditions (connectivity) construct were:

1. Using my Smartphone I get instant educational help from my university classmates
2. I connect with my university friends using my Smartphone for educational support
3. I collaborate with my university classmates using my Smartphone for my educational needs

6.2.1.6 The Effect of Hedonic Motivation on Behaviour Intention (BI ← HM)

Based on their findings from a research conducted in Hong Kong, Venkatesh et al. (2012) added three new constructs to the UTAUT model, which comprised of hedonic motivation, price and habit. These additions led to the birth of the UTAUT2 model. (Brown & Venkatesh, 2005) defined hedonic motivation as pleasure or happiness derived from using a technology, a factor which is a significant determinant of new technology adoption. In this thesis, hedonic motivation was found to have a significant positive relationship with the behavioural intention to use Smartphones for mobile learning.

Hypothesis five is thus supported. Researchers investigating technology acceptance have reported that hedonic motivation is instrumental as a determinant (Carlsson et al., 2006;

Oechslein et al., 2014; Raman & Don, 2013; Segura & Thiesse, 2015; Venkatesh et al., 2012; Xu, 2014; Yang, 2013; Yu, 2012). Most scholars in mobile learning acceptance and usage conceptualized hedonic motivation as perceived enjoyment; the majority of studies reported the significant influence of perceived enjoyment in relation to mobile technology acceptance and use for learning (Raman & Don, 2013; Wang et al., 2009; Yang, 2013).

In this research, hedonic motivation has been added as a core determinant of a student's behavioural intention to use the Smartphone as a mobile learning technology. As a significant predictor, hedonic motivation implies that the ability of learning content to provide an enjoyable experience is one of the factors that boosts m-learning acceptance. The three questionnaire items which were significant in predicting hedonic motivation in this research were:

1. Using my Smartphone for my education is entertaining
2. Using my Smartphone for my education is exciting
3. Using my Smartphone for my education is pleasing

It can be concluded from the comparative analysis of all the independent variables of this thesis that hedonic motivation has more of a determining impact upon the acceptance of Smartphones as mobile learning tools than social influence. This may be due to the fact that the usage of Smartphones for younger generations is driven less by social influence or facilitating conditions and more by the pleasure of using the device. The Smartphone is equally a multi-functional device. Not only is it a communication technology, but it also provides entertainment, navigational capabilities and personal assistance. It has a camera and a virtual drive that can be used to store personal data and information resources. It assumed that users gain immense pleasure and satisfaction from having the ability to access information immediately, to communicate instantly, and from using the wide range of entertainment options. Facilitating conditions are reliant upon the Smartphone's availability to support or facilitate the user's experience.

The use of Smartphones for m-learning is voluntary and university students comprise a population with varied backgrounds – diverse ethnicities, ages and genders. It is imperative to make the m-learning system playful and enjoyable to attract more users (Wang et al., 2009). Wang et al. (2009) recommends Lin, Wang, and Chou (2012)'s framework which proposes several categories of cognitive aspects, content characteristics and motivation for making m-learning more enjoyable and pleasurable.

Hedonic motivation can be considered an important motivator. Mobile learning developers can corroborate designing learning content and learning apps which are playful and pleasurable in order to appeal to students in this area (Wang et al., 2009). The usage of this device in an educational context, is typically determined by the unique intrinsic mobile learning experiences and their affordability (Xu, 2014).

6.2.1.7 The Effect of Price on Behaviour Intention (BI ← PR)

Among the three new constructs introduced in (Venkatesh et al., 2012) UTAUT2 model, price is considered the most important factor in determining the user's preference to utilise a particular technology. In short, the perceived financial cost significantly affects individual intention to use Smartphones for education.

Price value refers to the cost of purchasing the Smartphone and the associated charges (that is, the data plan and cell phone communication). Venkatesh et al. (2012)'s study provided enough significant evidence to explain the effect of behavioural intention to use technology after the induction of predictor constructs of UTAUT2 (hedonic motivation, price and habit). This thesis hypothesized that the price significantly effects the behaviour intention of students to use Smartphones as mobile learning tools.

However, the path coefficients of this item demonstrated negative values and did not show significance, therefore hypothesis H6 was not supported. This may be due to the fact that the cost of the Smartphone as a multi-utilitarian device is also shared for educational purposes. The results in the study are partially consistent with prior research (Lin & Wang, 2005; Luarn & Lin, 2005; Tsu Wei et al., 2009; Wong & Hiew, 2005), which also identified a negative relationship between the financial cost and the intention to use a technology. The results of this thesis demonstrate that an increase in cost (expenses for the handset, subscription fees and communication fees) will result in a decreasing adoption of Smartphones for education. Raman and Don (2013) posit that price is an important factor only where the user is made to bear the costs associated with the purchase of devices and services exclusively for the use of a particular technology.

The three main questionnaire items related to this hypothesis were:

1. My Smartphone is reasonably priced when used for my university education
2. At the current price, my Smartphone provides good value for my university education
3. Considering its benefits, my Smartphone cost is acceptable for my university education

In the case of Smartphones as a Bring Your Own Device (BYOD) learning tool, the price of both mobile devices and Internet data access are primary cost barriers to students. This research reflects that the affordable price, all students can afford to access online content using Smartphones.

An important difference between using Smartphones in a student setting and a university setting, is that the students usually bear the monetary costs of the device and the operational costs, whereas the universities do not. The cost and the mobile service data plan structure may have a marginal impact on students' use of Smartphone technology. As the above findings demonstrate, price did not prove to be the significant determinant for this thesis.

6.2.1.8 The Effect of Habit on Behaviour Intention (BI ← HA)

Habit is defined as an unconscious or automatic behaviour, or the extent to which people tend to perform behaviours automatically because of repetition (Limayem & Hirt, 2003). Habit is also defined as automaticity. Similarly, Venkatesh et al. (2012) argues that habit as a technology acceptance predictor is primarily viewed as behaviour. It is measured as the extent to which an individual believes the behaviour to be automatic.

An individual's habit differs from his/her reflexes. The researcher believe in order to become a habit, an activity requires learning cycles or a number of short-term repetitions, reinforcement, clarity of situation, interest, and ability to learn (Triandis, 1979). Human psychology researchers consider habit as an unconscious behaviour (Kim & Srivastava, 2007).

None of the six items which defined the habit construct loaded together as factors during the factor extraction stage. This may be the reason that the respondents feel anxious about using Smartphones for education, or they do not perceive themselves as habituated users. It is difficult to conclude whether habits and behaviour intention are linked. It can be believed that those who frequently use Smartphones for education are more likely to be habitual users. A significant impact of habit on behaviour intention could provide fruitful further research. Such a study would be worthwhile, as it is important for service providers to know whether user anxiety about using online services is dependent upon the technology or on the service itself, or if the anxiety is related to personal traits.

They are many studies which do not report habit as a significant determinant for predicting a user's intention to utilise a particular technology (Raman & Don, 2013; Segura & Thiesse, 2015). Segura and Thiesse (2015) claim that when investigating users' behaviour intention, it is obligatory that the survey participants use the technology in question for a reasonable period of time. Oulasvirta et al. (2012) posit that Smartphone applications that are frequently updated (new features, new interfaces and usability) lead to confusion, re-learning, or the abandonment of a service.

Many of the studies have also eliminated habit and price value constructs after finding them unrelated or insignificant. As many as nine studies from the meta-analysis set did not use Price while eleven studies did not consider habit to be a significant predictor construct. The resultant predictor variables of this research are very similar to the observed trend of findings in the field of technology acceptance using the UTAUT model.

Research studies exploring only behaviour intention considered removing habit as a determining construct (Alrawashdeh et al., 2012; Chang et al., 2015; Hackbarth et al., 2003; Segura & Thiesse, 2015; Wilson et al., 2010; Wu et al., 2008).

6.2.1.9 Set-I Hypothesis Conclusions

To confirm and consolidate the finding of the first set-I hypothesis of this research, a meta-analysis of the 20 latest research studies which had used UTAUT and UTAUT2 models for technology acceptance were analysed. The selection of research studies was made with the following criteria:

1. Assessing of behaviour intention of technology
2. Employment of the UTAUT2 model
3. Latest publication year
4. Related to the field of mobile technology
5. Used quantitative research methodology
6. Incorporated new moderators

The results from the selection criteria identified 20 research publications as listed in Table 60. Most of the studies used sample sizes that exceeded 250 participants. This thesis used a similar sample size. Performance expectancy came out to be the strongest and the most significant predictor with all of the 20 listed studies in Table 60 followed by effort expectancy and social influence as predictors of technology acceptance.

As explained earlier, due to the absence of any formal mobile learning program the effect of the social influence construct ceases to exist, and hence the effect was low with negative path coefficients. In the same context, facilitating conditions followed by hedonic motivation were the next best set of predictor constructs. Both price and habit were found to be less important predictor variables for assessing behaviour intention or technology acceptance. It is important to emphasise that all of the items of price predictor constructs were found to demonstrate negative path coefficients in this research.

Smartphones provide quicker access to content, the users have shorter intermittent interactions with their devices which make it difficult for the user to concentrate for long periods of time. Intermittent disruptions can make it hard to concentrate on formal learning tasks (Oulasvirta et al., 2012). It can be agreed that habits originating with Smartphones are inherently briefer than their preceding technologies, such as laptop-based habits, as well as being more pervasive throughout the day (Oulasvirta, Tamminen, Roto, & Kuorelahti, 2005). As stated earlier, in the absence of a formal regulated mobile learning initiative in the university, the formation of specific habits around using Smartphones for learning is quite remote. The descriptive statistics reveal that students use Smartphones for learning after their own personal motivation and initiative.

To further investigate the three remaining sets of hypotheses, this thesis investigates the significance of moderators (gender, educational level and context) in the acceptance of Smartphones as learning tools. Furthermore, in order to provide a more comprehensive understating of context as a moderator, this thesis differentiated between College of Engineering participants and those from the College of Education. As explained in detail in this thesis' methodology, these colleges have contrasting academic programs, curriculum, and durations of the study. A deeper dissection of the Inter and Intra contextual moderator effects of gender and educational levels are expected to provide an understanding of the role of context in the acceptance of Smartphone technology.

Table 60: Meta-Analysis of UTAUT and UTAUT2 Studies

No.	Author	Model	Sample	Technology	Path Coefficents							R^2
					PE	EE	SI	FC	HM	PR	HA	
1	Oechslein et al. (2014)	UTAUT2	266	News Personalization	0.352***	0.63*	0.091**	0.53**	0.050**	0.37**	0.446***	74.00%
2	Chang et al. (2015)	UTAUT2	1000	Mobile Banking	0.146*	0.163*	0.125*	0.225*		0.225		41.00%
3	Yang (2013)	UTAUT2	182	Mobile Learning (University Students)	0.152*	-0.041	0.200*		0.282***	0.160*	0.058	33.50%
4	Segura et al. (2015)	UTAUT2	346	Pervasive Information Systems	0.20**	0.10**	0.39***		0.22***	0.14***		67.00%
5	Harsono et al. (2014)	UTAUT2	419	Social Media (Univesity Students)	-0.291*	0.475*	0.251*	0.015*	-0.063*	0.027**	0.156*	87.10%
6	Carlsson et al. (2006)	UTAUT	300	Mobile devices/services	0.782***	0.619***	0.178***	0.035	0,199**			
7	Wu et al. (2008)	UTAUT	394	3G Mobile Service	0.419***	0.057	0.362***	0.228***				
8	SHI et al. (2008)	UTAUT	650	Infome-diaries	0.454*	0.116*	0.22*	0.179*				
9	Raman et al. (2013)	UTAUT2	320	Moodle Learning Management System	0.256**	0.178**	0.258**	0.632**	0.553**		0.019	29.50%
10	Zhang et al., (2010)	UTAUT2	195	Mobile Search	0.417***	0.099	0.241***		0.142***	0.256***		39.00%
11	YEE, (2015)	UTAUT2	250	Mobile e-Books	0.146*	0.073	-0.019	-0.069	0.285***	0.149 **	0.276***	42.25%
12	Estorninho, (2014)	UTAUT2	348	Mobil Hospitality	0.13**	0.14**	0.01	0.25***	0.09	0.01	0.07	62.00%
13	Alalwan et al. (2013)	UTAUT2	344	Mobile Banking	0.29***	0.29***			0.21***			62.00%
14	Xu (2014)	UTAUT2	3919	Social Network Games	0.101***		0.306***		0.164***	0.33*	0.216***	62.80%
15	Alrawashdeh et al. (2012)	UTAUT	290	Web-Based Training System	0.107***	0.175***	0.091***	0.265***				
16	Wang et al. (2009)	UTAUT	330	Mobile Learning (University Students)	0.26***	0.21***	0.12**		0.21***			68.00%
17	Venkatesh et al. (2012)	UTAUT2	1512	Mobile Internet Consumers	0.21***	0.16**	0.14*	0.16**	0.23***	0.14*	0.32***	74.00%
18	Wilson et al. (2010)	UTAUT	201	Information Technology	0.266**	-0.117*	0.251**	0.105			0.690***	
19	Yu (2012)	UTAUT	441	Mobile Banking	0.263***	0.027	0.664***	0.560**	0.146**	-0.279***		60.00%
20	Abdulwahab et al. (2012)	UTAUT2	191	Telecommunication Centre	0.280**	0.073	0.480***	0.154*	-0.085			32.00%

Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10

6.2.2 Set-II Effect of Moderators on Total Population (CX1+CX2):

The second set of research hypotheses were designed to explore group differences between gender and educational levels as moderating effects in the research questions. The aims are outlined below:

3. How does Smartphone acceptance differ with gender as moderator on the total population
    a. Gender CX1+CX2 (M:W)
4. How does Smartphone acceptance differ with educational level as moderator on the total population
    a. Educational level CX1+CX2 (UG:PG)

6.2.2.1 Gender Moderation CX1+CX2 (M:W):

The gender comparison Z scores in this thesis demonstrated that effort expectancy (EE), facilitating conditions (FC), hedonic motivation (HM) and price (PR) contrasts differed significantly in relation to the two different colleges (the Engineering College (CX1) and the Education College (CX2), particularly in relation to behaviour intention, or students' willingness to adopt Smartphones as mobile learning tools.

The same comparisons also revealed no statistically significant gender differences between the performance expectancy (PE), social influence (SI) and price (PR) constructs on behaviour intention to adopt Smartphones as mobile learning tools. Hence hypotheses *H9a, H11a, H12a* and *H13a* are supported. These findings are consistent with other studies (Lin, Lin, & Huang, 2011; Venkatesh et al., 2012). Hypotheses *H8a*, *H11a* and *H14a* are not supported as illustrated in Table 61.

The gender moderation group difference test identifies significant differences in perceiving performance expectancy as a predictor of using Smartphones as learning tools between Men and Women. The path coefficients show that Men perceive Smartphone technology to be two times as productive and helpful in improving academic performance than Women. However the group difference for this construct was not significant, hence hypothesis *H8a* is not supported. Thus performance expectancy and its significance level clearly indicates that the Smartphone is seen as an important tool and is expected to improve students' academic performance, grades and productivity.

Table 61: Path Coefficients and Z Scores for Three Hypothesis Set-II

Gender Moderation (CX1+CX2)							
Constructs	Men (CX1+CX2)		Women (CX1+CX2)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	**0.433**	***	**0.293**	***	-1.289	NS	H8a: Not Supported
BIN <--- EE	**0.383**	***	**0.557**	***	**2.452**	**	**H9a: Supported**
BIN <--- SI	**-0.111**	**	**-0.134**	**	-0.239	NS	H10a: Not Supported
BIN <--- FC	**0.301**	***	0.007	NS	**-3.349**	***	**H11a: Supported**
BIN <--- HM	0.087	NS	**0.244**	***	**2.065**	**	**H12a: Supported**
BIN <--- PR	**-0.120**	*	0.022	NS	**2.035**	**	**H13a: Supported**
BIN <--- HA	NA	NA	NA	NA	NA	NA	H14a: Not Supported

*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*

The group difference for effort expectancy was found to be significant with 2.452 standard deviations from the mean between Men and Women, as indicated from the path coefficients in Table 60. It can be assumed that both Men and Women find Smartphones effortless to use for education, with Women indicating significantly higher intensity than Men. The results are clearly indicative of this; both Men and Women perceive Smartphones as easy to use for educational purposes with a difference. Hypothesis *H9a* is thus supported.

The three variables, which constitute the social influence construct, attempted to find respondents' responses over the importance of support received from university faculty, peers and friends to use Smartphones for educational purposes. The negative path coefficients could be due to the fact that students today are more autonomous in choosing a learning technology irrespective of any social influence. The other reason could be that the university where this research was conducted does not include a formal mobile learning program; as such, there is an absence of an environment where faculty or peers encourage, foster or scaffold students' behaviours to use Smartphones for learning or similar academic activities. Hence this reflection of negative path coefficient can be an indicator of the absence of a mobile learning environment. Moreover, the significance level of path coefficients may indicate the importance of social influence as a factor which strongly influences the behaviour intention of students in using Smartphones for learning. To conclude, social influence between the two groups did not differ significantly and hence hypothesis H10a was not supported.

In terms of facilitating conditions, Men demonstrate stronger path coefficients than Women in using Smartphones for educational purposes. The response to this construct also reveal that Men intend to connect and collaborate with university peers and friends for educational needs. In contrast, it can be assumed that Women do not tend to use Smartphones for educational reasons. Group comparisons indicate that there exists a significant difference of –3.349 standard deviation from the mean, between the two genders of this thesis, in perceiving Smartphones as learning tools. Consequently, hypothesis *H11a* is supported by these results.

As demonstrated in Table 62, it can be mediated that Women found the use of Smartphones for education effortless. Connect (2013) found that Women tend to use Smartphones for social networking, entertainment, playing games and photography more than Men. From the group comparison results, the researcher supposes that, Women have better operational skills, which reflect their high path coefficients in effort expectancy. The engagement of Smartphones for social networking, entertainment and playing games might be an obstacle for them to use this device for education.

When users find mobile applications easy to use, it eliminates the need for supporting infrastructure like facilitating conditions (Venkatesh et al., 2003). This may explain why facilitating conditions are found to differ significantly between the two genders; Men, more than Women, prefer to communicate with friends and peers for educational purposes using Smartphones. Venkatesh et al. (2003) posit that predicting intention to adopt a technology in the presence of performance expectancy and effort expectancy constructs minimises the effect of facilitating conditions.

Table 62: Meta-analysis of Gender as a Moderator in UTAUT and UTAUT2 Models

No.	Author	Model	Sample Size	Technology	PE	EE	SI	FC	HM	PR	HA	Moderator
												Gender
1	Oechslein et al. (2014)	UTAUT2	266	News Personalization	N	N	N	N	N	N	N	**N**
2	Chang et al. (2015)	UTAUT2	1000	Mobile Banking	**M**	**W**	**M**	N	N	M	N	**M**
3	Yang (2013)	UTAUT2	182	Mobile Learning (University Students)								
4	Segura et al. (2015)	UTAUT2	346	Pervasive Information Systems								
5	Harsono et al. (2014)	UTAUT2	419	Social Media (Univesity Students)								
6	Carlsson et al. (2006)	UTAUT	300	Mobile devices/services								
7	Wu et al. (2008)	UTAUT	394	3G Mobile Service	W	W	W	M				**W**
8	SHI et al. (2008)	UTAUT	650	Infome-diaries								
9	Raman et al. (2013)	UTAUT2	320	Moodle Learning Management System								
10	Zhang et al., (2010)	UTAUT	195	Mobile Search	M	N	N	N				**N**
11	YEE, (2015)	UTAUT2	250	Mobile e-Books								
12	Estorninho, (2014)	UTAUT2	348	Mobil Hospitality	P	P	N	P	N	N	N	**P**
13	Alalwan et al. (2013)	UTAUT2	344	Mobile Banking								
14	Xu (2014)	UTAUT2	3919	Social Network Games	N	N	**M**	N	W	W	N	**M/W**
15	Alrawashdeh et al. (2012)	UTAUT	290	Web-Based Training System								
16	Wang et al. (2009)	UTAUT	330	Mobile Learning (University Students)	**M**	N	**M**	N				**M**
17	Venkatesh et al. (2012)	UTAUT2	1512	Mobile Internet Consumers	**M**	N	**W**	N	N	N	N	**M/W**
18	Wilson et al. (2010)	UTAUT	201	Information Technology								
19	Yu (2012)	UTAUT	441	Mobile Banking	**M**	**W**	N	M	N			**M**
20	Abdulwahab et al. (2012)	UTAUT2	191	Telecommunication Centre	**M**	**W**	**W**	N	N	N	N	**W**
				FINAL COUNT	**M**	**W**	**M/W**	**M**	**N**	**N**	**N**	

Notes: M:Men Moderated W: Women Moderated, P: Partially Moderated, N: Not Significant

The effect of hedonic motivation appears weak among the Men population in this study. It can be observed that the effect is significant among the Women, making it an important factor that could affect their intention to use Smartphones as learning tools. Hedonic motivation reflects a student's impression of Smartphones as entertaining, exciting and pleasing for educational use. This can indicate that the use of these devices for education is not laborious. High significant path coefficients of effort expectancy demonstrate that Women find more pleasure in using Smartphones for educational purposes than Men. The difference among the two genders for hedonic motivation is significant, with a standard deviation of 2.065 from the mean. Hence hypothesis *H12a* is supported. As reported earlier, Women tend to use Smartphones more than Men for entertainment and social networking and this provides them with intrinsic motivation and pleasure. Subsequently, Women are more likely to presume that the use of Smartphones for education will provide them with pleasing and entertaining effects, thus validating their hedonic motivation.

Price value as a predictor of the Smartphone as an m-learning tool was found to display a path coefficient of -0.120 at the significance level $P<0.1$ for Men (Lavrakas, 2008). Women may be less interested in price: it did not influence their behaviour intention towards Smartphones for education. The group comparison between the Men and Women population, with price as a predictor construct, showed a 2.035 standard deviation from the mean. Thus hypothesis *H13a* is supported.

All the items of the habit construct did not load into a single factor as explained in the results chapter of this thesis. Hence this study eliminated the habit construct from the discussion of this chapter.

To further consolidate the finding of gender as a moderator, a meta-analysis of the 20 latest publications which had adopted UTAUT and UTAUT2 models for technology acceptance were analysed. The findings of this research were very much in agreement with the trend observed in gender as a moderator with the above two mentioned models. Table 4 clearly demonstrates that gender was a significant moderator that effected UTAUT and UTAUT2 constructs in determining the behaviour intention of using the Smartphone as a learning tool. Furthermore, the effect of gender as a moderator varied with different significance levels and intensities. The meta-analysis also reflects that 10 out of 20 research studies listed show that gender significantly altered the behaviour intention to use a technology.

6.2.2.2 Educational Level Moderation CX1+CX2(UG:PG):

This study replaced age as a conventional moderator in the UTUAT2 model, owing to the academic environment of the study. Instead, the demographic data considered educational level as a moderator, as it better represents a moderating effect than the respondent's age.

After assessing the moderating effects of educational level (undergraduate:UG vs. postgraduate:PG), it was shown that none of the constructs proved to be significantly different between the undergraduate and postgraduate students in the total population of this study. This may indicates that the educational level does not moderate the behaviour intention of using Smartphones as mobile learning tools. Hence hypotheses *H8b*, *H9b*, *H10b*, *H11b*, *H12b*, *H13b* and *H14b* are not supported as shown in Table 63.

Table 63: Effect of Education Level as a Moderator for UTAUT2 Model

Educational Level Moderation (CX1+CX2)							
Constructs	**UG (CX1+CX2)**		**PG (CX1+CX2)**		**Z-Scores (Group Comparison)**	***P***	**Hypothesis Results**
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- **PE**	**0.376**	***	**0.383**	***	0.229	NS	H8b: Not Supported
BIN <--- **EE**	**0.469**	***	**0.457**	***	-0.290	NS	H9b: Not Supported
BIN <--- **SI**	**-0.129**	**	**-0.152**	***	-0.601	NS	H10b: Not Supported
BIN <--- **FC**	**0.178**	***	**0.109**	*	-0.835	NS	H11b: Not Supported
BIN <--- **HM**	**0.137**	***	**0.201**	***	0.848	NS	H12b: Not Supported
BIN <--- **PR**	-0.067	NS	-0.010	NS	0.800	NS	H13b: Not Supported
BIN <--- **HA**	NA	NA	NA	NA	NA	NA	H14b: Not Supported

*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*

The path coefficients of all the constructs, except price, were found to be significant with almost the same intensity between the undergraduates and postgraduates. Price value however showed negative path coefficients for both undergraduate and postgraduate students with low path coefficients. It can be established that both undergraduate and postgraduate students see performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation and price value with similar behaviour intentions to adopt Smartphones as learning tools.

Again, the performance expectancy and effort expectancy path coefficients for both undergraduates and postgraduates were very high with similar intensities and significance than any of the remaining constructs. Social influence, facilitating condition and hedonic motivation recorded low path coefficients, lesser intensities and significance levels. It is important to note that social influence had a negative intensity, which may be indicating the absence of faculty or peer support that would otherwise encourage the behaviour intention to use Smartphones for learning.

The resultant path coefficients can be compared to research studies which examined the effect of age as a moderator using the UTAUT1 models. The effect of age, as a moderator on UTAUT1 constructs toward behavioural intention, might indicate that age did not moderate the effect of performance expectancy and the effect of perceived credibility on behavioural intention. In a similar study (Oechslein et al., 2014) utilised the UTAUT2 model and considered experience as a moderating effect. He concluded that experience was a significant determinant of predicting technology acceptance.

Venkatesh et al. (2012) posit that hedonic motivation is stronger for younger Men towards behavioural intention to use technology, while the effect of price value is more important for older Women. Compeau and Higgins (1995) reported similar findings. This thesis may posit that with moderating significances of age, older people believe that using a new technology will require a lot of effort, a view not shared by the younger generation .

To further understand the effect of age as a moderating effect in assessing the behaviour intention of technology using the UTAUT models, this study conducted a meta-analysis of 20 research publications which used age as a moderator, as shown in Table 64. The research studies were selected with the five strict criteria. Out of 20 studies selected in the meta-analysis, only ten conducted age as a moderating condition to assess the behaviour intention to use technology. Out of the ten studies, two of them reported age as a non-significant moderator; one was found to have partially moderated behaviour intention while the remaining six studies reported varied moderating effects with each UTAUT construct.

The findings of this thesis are contrary to some of the findings in the field of technology acceptance; in other studies the age group is a moderator, which is analogous to educational level as a moderator in the current study. However, it can be postulated that as the age difference between the undergraduate and the postgraduate students does not vary considerably, the effect was marginal. The results might indicate that the moderation of undergraduate and postgraduate students has absolutely no effect whatsoever in any of the UTAUT2 constructs. Moreover, the study also reveal that the path coefficients of all the constructs, for both undergraduate and postgraduate students, show pronounced identical similarity and significance. This might be an indicator that both of these academic groups are similar in their perceptions of Smartphones as mobile learning tools.

Table 64: Meta-analysis of Gender as a Moderator in UTAUT and UTAUT2 Models

No.	Author	Model	Sample Size	Technology	Moderator	
					Age	Experience
1	Oechslein et al. (2014)	UTAUT2	266	News Personalization	NS	NS
2	Chang et al. (2015)	UTAUT2	1000	Mobile Banking	M	
3	Yang (2013)	UTAUT2	182	Mobile Learning (University Students)		
4	Segura et al. (2015)	UTAUT2	346	Pervasive Information Systems	M	M
5	Harsono et al. (2014)	UTAUT2	419	Social Media (Univesity Students)	M	
6	Carlsson et al. (2006)	UTAUT	300	Mobile devices/services		
7	Wu et al. (2008)	UTAUT	394	3G Mobile Service	M	
8	SHI et al. (2008)	UTAUT	650	Infome-diaries		
9	Raman et al. (2013)	UTAUT2	320	Moodle Learning Management System		
10	Zhang et al., (2010)	UTAUT	195	Mobile Search		M
11	YEE, (2015)	UTAUT2	250	Mobile e-Books		
12	Estorninho, (2014)	UTAUT2	348	Mobil Hospitality	PM	
13	Alalwan et al. (2013)	UTAUT2	344	Mobile Banking		
14	Xu (2014)	UTAUT2	3919	Social Network Games		M
15	Alrawashdeh et al. (2012)	UTAUT	290	Web-Based Training System		
16	Wang et al. (2009)	UTAUT	330	Mobile Learning (University Students)	M	M
17	Venkatesh et al. (2012)	UTAUT2	1512	Mobile Internet Consumers	M	
18	Wilson et al. (2010)	UTAUT	201	Information Technology		
19	Yu (2012)	UTAUT	441	Mobile Banking	NS	M
20	Abdulwahab et al. (2012)	UTAUT2	191	Telecommunication Centre	M	

Notes: M: Moderated, PM: Partially Moderated, NS: Moderator Not Significant

6.2.3 Set-III Hypotheses:

Inter Contextual Comparison: To provide a comprehensive understanding of the effect of context, the third set of research questions analyse the effect of gender (M:W) and educational level (UG:PG) independently of the two contexts (Inter contextual moderation):

4. How does Smartphone acceptance compare across the two contexts of this study?
    a. Context: (CX1:CX2)

5. How does Smartphone acceptance compare across the two contexts with gender as a moderator?
   a. Gender: CX1(M:W):CX2(M:W)
6. How does Smartphone acceptance compare across the two contexts with educational level as a moderator
   a. Educational level: CX1(UG:PG):CX2(UG:PG)

6.2.3.1 Context Moderation (CX1:CX2):

The principal goal of this research is to assess the contextual acceptance of Smartphones as mobile learning tools between two universities; the College of Engineering (CX1) and the College of Education (CX2). As was highlighted in the literature review, there is significant evidence that the use of technology varies contextually.

The significant group differences between the two contexts (CX1 and CX2) of this study reveal facilitating conditions and hedonic motivation as defining moderators among the seven constructs. Hypotheses *H18a* and *H19a* are proved while *H15a*, *H16a*, *H17a*, *H20a* and *H21a* were not proven, as shown in Table 65.

A typical mobile learner accumulates knowledge and information as he or she moves across time and space assimilating ideas and resources that are gained in contextual locations (Sharples et al., 2010). Learners learn across time, by revisiting knowledge that was gained earlier in different contexts. Mobile learners move in and out of engagement with technology. Mobile phone coverage areas or the lack of coverage can lead to inconsistent episodes of learning (Vavoula & Sharples, 2002). Hence a contextual learner may artfully engages with his context and technology, which helps him to create impromptu sites of learning.

A comparative assessment of all of the constructs reveals that the College of Engineering students (CX1) perceive with lesser path coefficient levels as opposed to the College of Education students (CX2) in the acceptance of Smartphones as mobile learning tools. Effort expectancy is viewed with the same intensity in both contexts. In short, students of both contexts may find Smartphones easy to use and are expected to become skilful in using them for educational purposes. Social influence among the students of CX2 was found to be negatively significant in influencing their behaviour intention to use the device. Social influence was not significant to CX1 students.

Table 65: Effect of Contexts as a Moderator on UTAUT2 Model

Constructs	CX1		CX2		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	0.328	***	0.409	***	0.724	NS	H15a: Not Supported
BIN <--- EE	0.424	***	0.490	***	1.274	NS	H16a: Not Supported
BIN <--- SI	-0.079	NS	-0.173	***	-1.333	NS	H17a: Not Supported
BIN <--- FC	0.315	***	0.021	NS	-3.581	***	H18a: Supported
BIN <--- HM	0.069	NS	0.267	***	2.518	**	H19a: Supported
BIN <--- PR	-0.066	NS	-0.059	NS	0.082	NS	H20a: Not Supported
BIN <--- HA	NA	NA	NA	NA	NA	NA	H21a: Not Supported

*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*

In contrast, facilitating conditions were found to be significant with CX1 students, but not with CX2 students, which might indicate that the Engineering students used Smartphones to get instant help from their university peers. This could be due to the fact that engineering is more technology intense, collaborative and involves task oriented projects, laboratory experiments and reports which often comprise of intense technology usage (Margaryan, Littlejohn, & Vojt, 2011).

The path coefficients for social influence and facilitating conditions between CX1 and CX2 students revealed a very important finding. CX1 students might not care for encouragement from faculty or peers when it came to using Smartphones for education. They might believe that the use of Smartphones was relevant to their education, and used them without any need for extrinsic encouragement. This is due perhaps to their strong experience with technology which is a vital part of their curriculum. Engineering students are often found to be techno savvy, and they design, simulate and analyse technology, which grants them expertise and confidence.

Meanwhile, CX2 students or those from the college of education, may have believed that there was no encouragement from peers and faculty to use Smartphones for education. This may perhaps be due to an absence of formal mobile learning programs at the university, as well as the fact that the educational curriculum for CX2 does not include studying technology, nor do they use it for educational related activities unlike the CX1 students. It is might be possible that encouragement and facilitating support from faculty and peers could change the perception of CX2 students towards using Smartphones in education.

While CX1 students showed negative non-significant path coefficient for social influence, CX2 students showed negative but significant values. This might indicate that CX1 students believe facilitating conditions are significant in their influence, which means that they are willing to use Smartphones to connect with their peers and friends to get educational support. On the same note, CX2 students might believe that the encouragement from faculty and friends is not important for them to use Smartphones in their learning.

Hedonic motivation was not a significant predictor for CX1 but was highly significant for CX2 which may be reflect that engineering students feel that the use of this device would be entertaining, exciting and pleasing.

This study started with the hypothesis that the acceptance of the Smartphone as a mobile learning device would be governed by the context of its application. In the case of this research study the two chosen contexts (A College of Engineering and a College of Education) offered an excellent opportunity to compare and contrast a typical contextual scenario of a typical university environment.

As discussed, the two contexts were chosen according to differences in their programs, curriculum, pedagogy, student aptitudes, required skills and lengths of study. The path coefficients and the group difference test reveal the differences between these two contexts; that is, that the use of Smartphones is contextual and increasingly correlated to the learners' educational environment.

The results demonstrate that the UTAUT2 model can be used to successfully identify the distinct effects in the use of Smartphones for education, and that these findings can be correlated across similar contextual educational settings.

6.2.3.2 Contextual Gender Moderation CX1(M:W):

The group comparison for CX1 Men and Women seemingly reveal that both the genders see Smartphones very differently. In the assessment of the group differences between the genders (Men and Women) of CX1, effort expectancy, social influence and price differed significantly between the two genders. There were no significant differences between genders in terms of performance expectancy, facilitating conditions and habit.. Therefore, *H16b*, *H18b* and *H20b* supported the hypothesis. *H15b, H18b, H19b and H21b* did not support the hypothesis, as illustrated in Table 66.

Table 66: Group Comparison of CX1 Men and Women

Gender Comparison CX1(M:W)							
Constructs	CX1(M)		CX1(W)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	**0.317**	***	**0.373**	***	0.601	NS	H15b: Not Supported
BIN <--- EE	**0.289**	***	**0.606**	***	**3.296**	***	**H16b: Supported**
BIN <--- SI	-0.046	NS	-0.111	NS	-0.678	NS	H17b: Not Supported
BIN <--- FC	**0.465**	***	0.004	NS	**-3.175**	***	**H18b: Supported**
BIN <--- HM	0.078	NS	0.086	NS	0.265	NS	H19b: Not Supported
BIN <--- PR	**-0.103**	*	0.064	NS	**1.856**	*	**H20b: Supported**
BIN <--- HA	NA	NA	NA	NA	NA	NA	H21b: Not Supported

*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*

Both genders positively perceive the use of Smartphones in education, and both might believe that their use will increase productivity, efficiency of learning and also positively affect their academic scores. Significantly, twice as Women found using Smartphones for education easy and effortless. Women appeared to be extremely confident in their use of Smartphones and might believe that they could become expert users of these devices.

The analysis also showed a negative but inconsistent response for social influence between both genders. This might imply that both Men and Women believe there was a lack of support for the use of Smartphones in education. This negativity could be due to the absence of any formal mobile learning program at the university in question. The analysis discovered that Men used Smartphones to get help and collaborate with their peers for education; conversely Women's engagement was not significant enough to draw any firm conclusions. In short, CX1 Men might believe that their academic performance and support is related to their connections with friends for educational support, while the Women in this context did not.

When asked about the pleasure they would derive from the use of Smartphones for education, the responses from the Women and Men of CX1 were not significant. Men might believe the current price of Smartphones and their operational costs did not justify their value for education, while Women might believe they did, but the responses were not reliable enough to make a definite judgment.

6.2.3.3 Contextual Gender Moderation CX2(M:W):

Contrary to CX1 findings, both the Men and Women of CX2 envisage the use of Smartphones very similarly. The only difference among the CX2 Men and Women related to performance expectancy (PE). Hence, *H15c* proves the hypothesis while *H16c, H17c, H18c, H19c, H20c* and *H21c* do not, as shown in Table 67.

Table 67: Group Comparisons of CX2 Men and Women

Gender Comparison CX2 (M:W)							
Constructs	CX2 (M)		CX2(W)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	0.673	***	0.276	***	-2.498	**	H15c: Supported
BIN <--- EE	0.509	***	0.492	***	-0.029	NS	H16c: Not Supported
BIN <--- SI	-0.234	***	-0.118	*	1.280	NS	H17c: Not Supported
BIN <--- FC	0.022	NS	0.001	NS	-0.174	NS	H18c: Not Supported
BIN <--- HM	0.119	NS	0.326	***	1.346	NS	H19c: Not Supported
BIN <--- PR	-0.155	**	-0.001	NS	1.618	NS	H20c: Not Supported
BIN <--- HA	NA	NA	NA	NA	NA	NA	H21c: Not Supported

*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*

Comparisons of these groups reveal that CX2 Men might have perceived that Smartphones will improve their academic performance and grades at two times the rate of CX2 Women (M:W). The analysis also revealed that more CX2 Men than CX2 Women believe using Smartphones in education might increase their productivity, efficiency of learning and academic scores. Around three times the Men in CX2 showed a positive significant response to performance expectancy than the Women. In addition to this, the analysis showed that both CX2 Men and Women might have believed that the use of Smartphones for education was effortless.

The analysis further revealed that both Men and Women might not believe that there was any support or encouragement, to use Smartphones for education, by peers or faculty. Neither the CX2 Men nor the CX2 Women seemed open to using Smartphones for getting help or collaborating with their peers and faculty; but this response was insignificant. The analysis might also be understood that an insignificant response from Men as to deriving pleasure when using Smartphones for education. On the other hand, CX2 Women showed a significant response to the same queries. This might showe that CX2 Women believed the use of Smartphones for education would be exciting and fun. The price of Smartphones as valued against their educational benefits was perceived negatively by CX2 Men. The response by the CX2 Women to the same queries was not significant.

6.2.3.4 Conclusion: Inter Contextual Gender Moderation CX1(M:W):CX2(M:W):

An investigation into the behavioural intentions (to adopt Smartphones) between the Men and Women within each of the two contexts revealed that Performance expectancy, Effort expectancy, Facilitating conditions and Price were perceived differently within each of the two contexts. Social influence and Hedonic motivation were perceived similarly between the genders of each of the two contexts - as shown in Table 68.

Men may seem to believe that being connected with friends and peers aided them in their education. However, it can be perceived that they did not find Smartphones entertaining for education. This might suggests that Men are more task-oriented when using Smartphones, while Women tend to enjoy their Smartphones and do not actively seek educational help or support though them.

Table 68: CX1 and CX2 gender group comparison

Constructs			Hypothesis CX1(M:W)	Hypothesis CX2(M:W)
BIN	<---	**PE**	H15b: Not Supported	**H15c: Supported**
BIN	<---	**EE**	**H16b: Supported**	H16c: Not Supported
BIN	<---	**SI**	H17b: Not Supported	H17c: Not Supported
BIN	<---	**FC**	**H18b: Supported**	H18c: Not Supported
BIN	<---	**HM**	H19b: Not Supported	H19c: Not Supported
BIN	<---	**PR**	**H20b: Supported**	H20c: Not Supported
BIN	<---	**HA**	H21b: Not Supported	H21c: Not Supported

6.2.3.5 Contextual Educational Level Moderation CX1(UG:PG):

The contextual educational level moderation (between undergraduate UG and postgraduate PG) for the Engineering College students (CX1) disclose only hedonic motivation (HM) as significantly different between the two educational levels (UG:PG). Hence hypothesis *H19d* is proven to be true and *H15d*, *H16d*, *H17d*, *H18d*, *H20d* and *H21d* are not as shown in Table 69.

Table 69: Group Comparison of CX1 Undergraduate and Postgraduate

Educational Level Comparison CX1(UG:PG)							
Constructs	CX1(UG)		CX1(PG)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	**0.325**	***	**0.296**	**	0.155	NS	H15b: Not Supported
BIN <--- EE	**0.438**	***	**0.261**	**	-1.211	NS	H16b: Not Supported
BIN <--- SI	-0.044	NS	-0.079	NS	-0.505	NS	H17b: Not Supported
BIN <--- FC	**0.309**	***	**0.344**	***	0.368	NS	H18b: Not Supported
BIN <--- HM	0.014	NS	**0.189**	**	**1.742**	*	**H19b: Supported**
BIN <--- PR	-0.086	NS	-0.004	NS	0.653	NS	H20b: Not Supported
BIN <--- HA	NA	NA	NA	NA	NA	NA	H21b: Not Supported
*Notes: ***p-value < 0.01; **p-value < 0.05; *p-value < 0.10*							

The analysis might reveal that both undergraduates and postgraduates from CX1 equally believed that using Smartphones for education would increase their productivity, ease of learning and academic scores. They both might also strongly believe that using Smartphones for education was easy and effortless. Next, the analysis displays a non-significant response from both the undergraduates and postgraduates from CX1 concerning social influence. The analysis further revealed that both undergraduates and postgraduates from CX1 might use Smartphones for collaborating with peers and faculty for education. The analysis delved into the pleasure that users derived from using Smartphones for education: the results were not significant for undergraduates.

On the other hand, postgraduates indicated that they might have enjoyed using Smartphones for education. The results for finding the price of Smartphones compatible with their value in education was not significant for either undergraduates or postgraduates. More than any other comparative grouping, the CX1 undergraduates and postgraduates showed the most unity in their responses.

6.2.3.6 Contextual Educational Level Moderation CX2(UG:PG):

The contextual educational level moderation (between undergraduate UG and postgraduates PG) for the Engineering College students (CX1) discloses only hedonic motivation (HM) as significantly different between the two educational levels (UG:PG). Hence hypothesis *H19d* is proven while and *H15d*, *H16d*, *H17d*, *H18d*, *H20d* and *H21d* are not, as presented in Table 70.

CX2 (UG:PG) The comparative analysis between undergraduates and postgraduates showed that both strongly believed that using Smartphones for education would increase productivity, ease of learning and academic scores. The response from CX2 postgraduates was nearly twice as high as that of the undergraduates. Both undergraduates and postgraduates might have strongly believed that the use of Smartphones for education was effortless. The analysis revealed that both CX2 undergraduates and postgraduates did not feel encouraged by peers or faculty to use Smartphones for educational purposes. But these negative values did not impact on their use of Smartphones in education. The response to facilitating conditions was not significant in either the undergraduates or the postgraduates. The analysis further revealed that the CX2 undergraduates may have enjoyed using Smartphones for education, while the response from CX2 postgraduates was not significant. The analysis for the price of Smartphones on perceived value of use in education was not significant for either undergraduates or postgraduates.

Table 70: Group Comparison of CX2 Undergraduates and Postgraduates

Educational Level Comparison CX2 (UG:PG)							
Constructs	CX2 (UG)		CX2 (PG)		Z-Scores (Group Comparison)	P	Hypothesis Results
	Path Coefficient	P	Path Coefficient	P			
BIN <--- PE	**0.370**	***	**0.622**	***	1.531	NS	H15c: Not Supported
BIN <--- EE	**0.506**	***	**0.373**	***	-0.995	NS	H16c: Not Supported
BIN <--- SI	**-0.160**	***	**-0.199**	**	-0.579	NS	H17c: Not Supported
BIN <--- FC	0.045	NS	-0.018	NS	-0.576	NS	H18c: Not Supported
BIN <--- HM	**0.277**	***	0.170	NS	-0.914	NS	H19c: Not Supported
BIN <--- PR	-0.075	NS	-0.019	NS	0.675	NS	H20c: Not Supported
BIN <--- HA	NA	NA	NA	NA	NA	NA	H21c: Not Supported

*Notes: ***p-value < 0.01; **p-value < 0.05; *p-value < 0.10*

6.2.3.7 Conclusion: Inter Contextual Educational Level Moderation CX1(UG:PG):CX2(UG:PG):

Excluding Hedonic Motivation, no major change was revealed after an Inter contextual assessment of education levels was conducted (in order to assess the students' behavioural intention to adopt Smartphones). Hedonic motivation was the only difference that was found among the Undergraduate and Postgraduate groups of Engineering students - as shown in Table 71.

Table 71: CX1 and CX2 educational group comparison

Constructs	Hypothesis CX1(UG:PG)	Hypothesis CX2(UG:PG)
BIN <--- **PE**	H15b: Not Supported	H15c: Not Supported
BIN <--- **EE**	H16b: Not Supported	H16c: Not Supported
BIN <--- **SI**	H17b: Not Supported	H17c: Not Supported
BIN <--- **FC**	H18b: Not Supported	H18c: Not Supported
BIN <--- **HM**	**H19b: Supported**	H19c: Not Supported
BIN <--- **PR**	H20b: Not Supported	H20c: Not Supported
BIN <--- **HA**	H21b: Not Supported	H21c: Not Supported

6.2.4 Set-IV Hypothesis:

Intra Contextual Comparison: The fact that the two contexts of this research offer different literacies, learning activities, academic tasks, course assessments, program schedules and curriculum syllabi, a deeper Intra contextual comparison will aid in understanding the acceptance of Smartphones as mobile learning devices. To assess this effect, the two groups were tested for intra group contextual difference as mentioned below.

3. How does Smartphone acceptance compare across the two contexts for the same gender moderator group?
    a. CX1(M):CX2(M): Comparison of acceptance by Men (gender moderator) across the two contexts
    b. CX1(W):CX2(W): Comparison of acceptance by Women (gender moderator) across the two contexts

4. How does Smartphone acceptance compare across the two contexts for the same educational level moderator group
    a. CX1(UG):CX2(UG): Comparison of acceptance by undergraduates (educational level moderator) across the two contexts
    b. CX1(PG):CX2(PG): Comparison of acceptance by postgraduates (educational level moderator) across the two contexts

6.2.4.1 Intra Gender Moderation Men CX1(M):CX2(M):

The contextual Intra Men gender moderation (between CX1 and CX2) reveals significant differences in performance expectancy, effort expectancy, social influence and facilitating conditions. Hence hypotheses *H22a, H23a, H24a* and *H25a* were proven to be true while *H26a, H27a and H28a* were not, as presented in Table 72.

The analysis revealed that Men from both contexts may have believed that using Smartphones for education would increase their productivity, efficiency of learning and academic scores. The analysis also showed that the response from the CX2 Men was twice as high as the response from the CX1 Men. The analysis found that students from both contexts may reflect using Smartphones for education was effortless. Similar to the PE pattern, CX2 Men showed twice as high a response as that of CX1 Men.

Table 72: Group Comparison of CX1and CX2 Male

Intra Context "Men" Gender Comparison CX1(M):CX2 (M)									
Constructs			CX1(M)		CX2(M)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
			Path Coefficient	*P*	Path Coefficient	*P*			
BIN	<---	PE	**0.317**	***	**0.673**	***	**2.373**	**	**H22a: Supported**
BIN	<---	EE	**0.289**	***	**0.509**	***	**2.054**	**	**H23a: Supported**
BIN	<---	SI	-0.046	NS	**-0.234**	***	**-1.935**	*	**H24a: Supported**
BIN	<---	FC	**0.465**	***	0.022	NS	**-3.583**	***	**H25a: Supported**
BIN	<---	HM	0.078	NS	0.119	NS	0.372	NS	H26a: Not Supported
BIN	<---	PR	**-0.103**	*	**-0.155**	**	-0.641	NS	H27a: Supported
BIN	<---	HA	NA	NA	NA	NA	NA	NA	H28a: Not Supported

*Notes: ***p-value < 0.01; **p-value < 0.05; *p-value < 0.10*

The study also revealed that the CX2 Men might not believe that the use of Smartphones for education was encouraged by their faculty and peers, while the response of CX1 Men was not significant. The response from the CX1 Men may suggest that they used Smartphones for getting help and collaborating in education as facilitating conditions, while the response from the CX2 Men was very minimal and not significant. The response to hedonic motivation was not significant for Men from both contexts. The price of Smartphones in relation to their educational benefits was perceived significantly negative by the Men of both contexts towards behaviour intention to use Smartphones for education.

The comparative results might indicate that the Men from the engineering college increasingly perceive the productive use of Smartphone as a serious learning tool. (Margaryan et al., 2011) argue that engineering students are digitally savvy: they are deemed more ‘digital natives’ than other social science students owing to their extensive use and experience. Hence they might prefer more technology tools for formal learning.

6.2.4.2 Intra Gender Moderation Women CX1(W):CX2(W):

Comparing the Women’s responses from both contexts revealed that both groups believed that the use of Smartphones in education could increase their productivity, efficiency of learning and academic scores. Both could find the use of Smartphones for education effortless.

The results revealed that CX2 Women might have not found any encouragement from faculty or peers regarding the use of Smartphones in education. The response from the CX1 Women was not significant. The results from Women in both contexts did not reveal any significant details in regards to facilitating conditions. The analysis also demonstrates that CX2 Women may find the use of Smartphones for education was exciting and fun, while the responses from CX1 Women were not significant. The Women’s responses regarding price was not significant in either context. Hence only hypothesis *H26b* was supported while all others were not, as presented in Table 73.

Table 73: Group Comparison of CX1and CX2 Women

Intra Context "Women" Gender Comparison CX1(W):CX2 (W)									
Constructs			CX1(W)		CX2(W)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
			Path Coefficient	*P*	Path Coefficient	*P*			
BIN	<---	PE	**0.373**	***	**0.276**	***	-0.806	NS	H22b: Not Supported
BIN	<---	EE	**0.606**	***	**0.492**	***	-1.013	NS	H23b: Not Supported
BIN	<---	SI	-0.111	NS	**-0.118**	*	0.068	NS	H24b: Not Supported
BIN	<---	FC	0.004	NS	0.001	NS	-0.039	NS	H25b: Not Supported
BIN	<---	HM	0.086	NS	**0.326**	***	**1.773**	*	**H26b: Supported**
BIN	<---	PR	0.064	NS	-0.001	NS	-0.815	NS	H27b: Not Supported
BIN	<---	HA	NA	NA	NA	NA	NA	NA	H28b: Not Supported
*Notes: ***p-value < 0.01; **p-value < 0.05; *p-value < 0.10*									

The group comparisons reveal that both Women's groups may accept pleasure as the driving motivator for using Smartphones in education. Consequently the two Women groups may perceive the use of Smartphones for education similarly. This finding is clearly in contrast with that of the Men group.

6.2.4.3. Conclusion: Intra Contextual Gender Moderation CX1(M):CX2(M): and CX1(W):CX2(W)

The comparison of each gender group between the two contexts reveals that their behaviour contrasts sharply in relation to factors affecting the use of Smartphones as educational tools. The Men belonging to both CX1 and CX2 might see the acceptance of Smartphones with significantly different acceptance levels; at least four out of the seven constructs from the UTAUT2 model demonstrated group differences.

For the Men of both contexts, Performance expectancy, Effort expectancy, Social influence and Facilitating conditions were perceived with significant differences. Between the Women of both contexts, only Hedonic motivation came out significantly different as shown in Table 74.

Table 74: CX1 and CX2 Men and Women group comparison

Constructs			Hypothesis CX1(M):CX2 (M)	Hypothesis CX1(W):CX2 (W)
BIN	<---	PE	**H22a: Supported**	H22b: Not Supported
BIN	<---	EE	**H23a: Supported**	H23b: Not Supported
BIN	<---	SI	**H24a: Supported**	H24b: Not Supported
BIN	<---	FC	**H25a: Supported**	H25b: Not Supported
BIN	<---	HM	H26a: Not Supported	**H26b: Supported**
BIN	<---	PR	H27a: Not Supported	H27b: Not Supported
BIN	<---	HA	H28a: Not Supported	H28b: Not Supported

6.2.4.4 Intra Educational Level Moderation CX1(UG):CX2(UG):

The thesis has revealed that undergraduates from both contexts believe that the use of Smartphones in education would increase productivity, efficiency of learning and academic scores. The study has also revealed that undergraduates from both contexts agree that the use of Smartphones in education is effortless.

CX2 undergraduates believed that there was no encouragement or support from faculty and peers regarding the use of Smartphones in education. In contrast the response from CX1 was not significant. The analysis found that CX1 undergraduates used Smartphones for help and collaboration in their studies, while the response from CX2 was not significant. CX2 undergraduates found the use of Smartphones in education fun and exciting, while the response from CX1 undergraduates was not significant. Undergraduates from both contexts indicated price was not significant. Hence hypotheses *H25c and H26c* were proven to be true while others were not, as presented in Table 75.

Table 75: Group Comparison of CX1 and CX2 Undergraduate Educational Level

Intra Contex "Under Graduate" Educational Level Comparison							
Constructs	CX1(UG)		CX2(UG)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	**0.325**	***	**0.370**	***	0.533	NS	H22c: Not Supported
BIN <--- EE	**0.438**	***	**0.506**	***	1.068	NS	H23c: Not Supported
BIN <--- SI	-0.044	NS	**-0.160**	***	-1.319	NS	H24c: Not Supported
BIN <--- FC	**0.309**	***	0.045	NS	**-2.507**	**	**H25c: Supported**
BIN <--- HM	0.014	NS	**0.277**	***	**2.743**	***	**H26c: Supported**
BIN <--- PR	-0.086	NS	-0.075	NS	-0.031	NS	H27c: Not Supported
BIN <--- HA	NA	NA	NA	NA	NA	NA	H28c: Not Supported
*Notes: ***p-value < 0.01; **p-value < 0.05; *p-value < 0.10*							

Conclusion: Undergraduate and postgraduate groups in both contexts reported that their behaviour intentions are similar in relation to using the Smartphone for education. There was a difference of opinion for facilitating conditions and hedonic motivation.

6.2.4.5 Intra Educational Level Moderation CX1(PG):CX2(PG):

The analysis demonstrates that postgraduates from both contexts believed that the use of Smartphones for education would increase their productivity, efficiency of learning and academic scores. The response from the CX2 postgraduates was twice as high as the response from CX1. The analysis also found that postgraduates from both contexts may find the use of Smartphones in education effortless.

CX2 postgraduates might have not believed that there was any encouragement or support from faculty and peers regarding the use of Smartphones for education, while CX1 responses were not significant. The analysis revealed that CX1 postgraduates might have used Smartphones for getting help and collaborating in their education, while CX2 postgraduate responses were not significant. The CX1 postgraduates might have seen the use of Smartphones as fun and exciting, while the responses from CX2 postgraduates were not significant. The response from the postgraduates from both the contexts was not significant for price. Hence only hypothesis *H25d* was proven to be true while all others were not, as presented in Table 76.

Table 76: Group Comparison of CX1 and CX2 Postgraduate Educational Level

Intra Contex "Post Graduate" Educational Level Comparison CX1(PG):CX2 (PG)							
Constructs	CX1(PG)		CX2(PG)		Z-Scores (Group Comparison)	*P*	Hypothesis Results
	Path Coefficient	*P*	Path Coefficient	*P*			
BIN <--- PE	**0.296**	**	**0.622**	***	1.529	NS	H22d: Not Supported
BIN <--- EE	**0.261**	**	**0.373**	***	0.955	NS	H23d: Not Supported
BIN <--- SI	-0.079	NS	**-0.199**	**	-1.179	NS	H24d: Not Supported
BIN <--- FC	**0.344**	***	-0.018	NS	**-2.893*** **	***	**H25d: Supported**
BIN <--- HM	**0.189**	**	0.170	NS	-0.354	NS	H26d: Not Supported
BIN <--- PR	-0.004	NS	-0.019	NS	-0.124	NS	H27d: Not Supported
BIN <--- HA	NA	NA	NA	NA	NA	NA	H28d: Not Supported
*Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10*							

6.2.4.6 Conclusion: Intra Contextual Educational Level Moderation CX1(UG):CX2(UG): Vs CX1PG):CX2(PG)

The groups of Undergraduate and Postgraduate students were each compared across both contexts. This revealed that the Undergraduates between the two contexts perceived the adoption of Smartphones for education differently with Facilitating conditions and Hedonic motivation as the influencing factors - as shown in Table 77.

Table 77: CX1 and CX2 undergraduate and postgraduate group comparison

Constructs	Hypothesis CX1(UG):CX2 (UG)	Hypothesis CX1(PG):CX2 (PG)
BIN <--- PE	H22c: Not Supported	H22d: Not Supported
BIN <--- EE	H23c: Not Supported	H23d: Not Supported
BIN <--- SI	H24c: Not Supported	H24d: Not Supported
BIN <--- FC	**H25c: Supported**	**H25d: Supported**
BIN <--- HM	**H26c: Supported**	H26d: Not Supported
BIN <--- PR	H27c: Not Supported	H27d: Not Supported
BIN <--- HA	H28c: Not Supported	H28d: Not Supported

However, the Postgraduate students of both the two contexts responded differently with Facilitating conditions as the key factor towards accepting Smartphones for education.

6.3 Research Summary

This thesis' primary goal was to assess mobile learning acceptance by conducting a comparative study for acceptance of Smartphones as mobile learning tools, using two different contexts. Smartphones provide students with a wealth of creative options to enhance their classroom experience; these include access to the internet for research and referencing, instant communication channels, the ability to use the camera to capture material written on the whiteboard or catalogue an important lecture moment, illustrates notes, convert Smartphones into classroom "clickers" that can answer multiple-choice questions, record lectures with voice memos, use inbuilt bar codes and quick response code scanners to find relevant websites and keep in track of academic schedules.

The literature review conducted in this thesis revealed that presently there are very few academic institutions that have implemented the Smartphone as a learning tool in their classrooms. The UTUAT2 model was chosen to analyse the data and has been found to successfully predict 70 % of the variances in behavioural intention to use a technology.

The purpose of the current study was to empirically extend the UTAUT2 model by incorporating and developing new variables specific to the context of our study in order to explain the development of individuals' behavioural intentions towards the use of smartphones in higher education.

The research model (UTAUT2) adds to the understanding and knowledge base of technology acceptance theory and mobile learning. After conducting the literature review and defining the research problem the researcher conducted a Pre-Pilot and a Pilot study to design the research instrument, understand the development and implementation of the survey instrument, conduct initial validation and to conduct statistical analysis required to test the hypothesis of this research. The survey instrument was developed through an iterative process, which focused on refining the language, its usability and ability to acquire descriptive data which would help to highlight the current and perceptive potential use of Smartphones in university education as perceived by the students. This study conducted appropriate methods to test the reliability and validity of the instrument after conducting a detailed meta-analysis of 44 academic publications from the field of technology acceptance and Smartphone based mobile learning. Instrument reliability, model fit and validity criteria such as construct and content validities were analysed and confirmed.

All of the results established excellent levels of reliability and validity, defining the appropriateness to proceed for the multi-variate regression analysis. This research also presented a structured and methodological step to extract data for the latent variables through the use of principal component factor analysis. This step of data extraction aided in the removal of scale items that did not correlate well during the factor extraction stage.

To test the seven constructs of the UTAUT2 model against the behaviour intention to use Smartphones for learning by the two contexts of the study, four sets of hypotheses were formulated based on the research question of this study.

6.3.1 Hypotheses Conclusions

The first set (Set-I) of hypotheses was designed to establish the relevance of the UTAUT2 model, while the results were used to assess the UTAUT2 model's parameters. Five out of the seven constructs predicted the acceptance of Smartphones as mobile learning tools for the total sample population.

The second set (Set-II) was formulated to check the moderation of gender and educational level on the total sample population. It was found that performance expectancy, effort expectancy and social influence were significant for both Men and Women undergraduates and postgraduates in both contexts. Facilitating conditions and price for both contexts were significant determinants. Women in both contexts reported high levels of hedonic motivation. Undergraduate and postgraduate students from both contexts highlighted the importance of facilitating conditions and hedonic motivation as significant determinants.

The Third Set (Set-III - Inter Contextual Moderation). The study analysed the effects of gender and educational level across both contexts. Performance expectancy and effort expectancy were found to be significant in both contexts. For CX1, facilitating conditions was a significant determinant, whereas in CX2 social influence and hedonic motivation were significant determinants.

CX1:CX2: performance expectancy and effort expectancy in both context were significant determinants. The response for social influence was negatively significant only for CX2. The response to hedonic motivation was only significant in CX2, while the response to facilitating conditions was only significant in CX1. Neither context responded significantly to price.

CX1(M):CX1(W): The response from CX1 Men and Women was unanimously significant for performance expectancy and effort expectancy. Men reported the importance of facilitating conditions and responded negatively to price. All other responses from either gender were not significant.

CX2(M):CX2(W): CX2 Men and Women showed a significant response to performance expectancy and effort expectancy. Both responded negatively to social influence. CX2 Women's response to hedonic motivation was notable, while CX2 Men responded negatively to price. All other responses from either moderator were not significant.

CX1(UG):CX1(PG): The response from both undergraduates and postgraduates was significant for performance expectancy, effort expectancy and facilitating conditions. The response from the postgraduates was also significant for hedonic motivation. All other responses from either moderator were non-significant.

CX2(UG):CX2(PG): The response from both CX2 undergraduates and postgraduates was significant for performance expectancy and effort expectancy, while the response was unanimously, negatively significant for social influence. Men also responded significantly to hedonic motivation. All other responses from either moderator were non-significant.

The general trend observed among all of the moderators was universally positive. There was a significant response to performance expectancy and effort expectancy.

The Fourth Set (Set-IV Intra Contextual Moderation). The study analysed the effects of gender and educational levels between similar moderators in both of the contexts.

CX(M):CX(M): The Men from both contexts responded significantly to performance expectancy and effort expectancy. CX2 Men also responded negatively to social influence, while CX1 Men responded significantly to facilitating conditions. All other responses from either moderator were non-significant.

CX(W):CX(W): The Women from both contexts responded significantly to performance expectancy and effort expectancy. CX2 Women gave a negatively significant response to social influence, while giving a significant response to hedonic motivation. All other responses from either moderator were non-significant.

CX1(UG):CX2(UG): The responses from undergraduates in both contexts were significant for performance expectancy and effort expectancy. CX2 Women also gave a negatively significant response to social influence, and a significant response to hedonic motivation. The CX1 undergraduates' responses to facilitating conditions were significant. All other responses from either moderator were not significant.

CX1(PG):CX2(PG): The response from the postgraduates from both contexts was significant for performance expectancy and effort expectancy. The CX2 postgraduates also gave a negatively significant response for social influence. CX1 postgraduates gave significant responses to facilitating conditions and hedonic motivation. All other responses from either moderator were not significant.

6.3.2 Summary of Z-Score Group Differences:

Set II hypothesis displayed the complete and overall responses by both contexts to the study's constructs. Out of the seven constructs, both contexts differed in their responses to five. Those five constructs were performance expectancy, effort expectancy, social influence, facilitating conditions and hedonic motivation.

Set III hypothesis displayed group differences between the moderators within both contexts together. Men and Women from both contexts did not show any differences in terms of performance expectancy and social influence. The differences arose in relation to effort expectancy, facilitating conditions, hedonic motivation and price. There were no group differences between undergraduates and postgraduates from both contexts.

Set IV hypothesis displayed the group differences between the contexts, the group differences between the genders within each context, and the group differences between undergraduates and postgraduates in each context. Both contexts agreed on performance expectancy, effort expectancy, social influence and price. Simultaneously, both contexts shared group differences in terms of facilitating conditions and hedonic motivation. A summary of all the four set hypothesis is presented in the Table 78.

Table 78: All Four Set Hypothesis Group Difference (Z-Scores)

	Set-1	Set-II		Set-III					Set-IV			
Constructs	CX	Gen	Edu Lev	Context	Gender		Edu Lev		Gender		Edu Lev	
		M:W CX	UG:PG CX	(CX1:CX2)	M:W (CX1)	M:W (CX2)	UG:PG (CX1)	UG:PG	M CX1:CX2	W CX1:CX2	UG CX1:CX2	PG CX1:CX2
BIN PE	Y	N	N	N	N	Y	N	N	Y	Y	N	N
BIN EE	Y	Y	N	N	Y	N	N	N	Y	N	N	N
BIN SI	Y	N	N	N	N	N	N	N	Y	N	N	N
BIN FC	Y	Y	N	Y	Y	N	N	N	Y	N	Y	Y
BIN HM	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N
BIN PR	N	Y	N	N	Y	N	N	N	N	N	N	N
BIN HA	N	N	N	N	N	N	N	N	N	N	N	N

Y: Hypothesis Proved, N: Hypothesis Not Proved

6.4 Hypothesis Discussion

This thesis is primarily interested in the acceptance of Smartphones for mobile learning in university education. The main reason this researcher instigated this study was to learn more about the subtleties of Smartphone adoption in a contextual underpinning. It aims to promote and help educate individuals about the potentials of Smartphones for formal and informal learning. Smartphones can provide instant feedback and communication support. This thesis therefore aims to identify the technology's immense potential.

This thesis represents a significant contribution toward understanding the acceptance of Smartphones in a university setting. The study measured college students' acceptance in two contexts (a College of Engineering and a College of Education) from a large university in New Zealand. This study adopted Venkatesh et al. (2012)'s UTAUT2 technology acceptance model. The students' acceptance of Smartphone technology was measured by modifying a technology acceptance model. Participants in this study were both undergraduate and postgraduate students enrolled during the academic year 2013-14. This study confirms the ability of the adopted model to determine a user's acceptance of Smartphones as mobile learning tools.

A few modifications were made to the main UTAUT2 model owing to the scope, context and research methodology adopted for this study. The construct social influence was revised as a combination of peers, friends and faculty while the educational connectivity was included as a major facilitating condition. The survey tool used to measure technology acceptance contained 62 statements pertaining to the various constructs used after conducting a meta-analysis of survey instruments in well cited research studies.

The participants indicated the strength of their agreement with each statement by responding to them with a seven item Likert scale ranging from strongly agree (4) to strongly disagree (1) and no opinion (0). The data was analysed to determine statistical validity with IBM SPS (PCA and CFA). The hypotheses were later confirmed by conducting Structural Equation Modelling path analysis to determine the students' perceptions and behavioural intent towards the use of Smartphones as mobile learning devices. The data produced by the statistical analysis provides a basis for responding to individual research hypotheses. A comparative assessment of all seven factors (that influence the acceptance of Smartphones against their significance with respect to the four sets of hypotheses) reveals Performance expectancy and Effort expectancy as the strongest predictors among all the groups. Facilitating conditions and Hedonic motivation were the next strongest predictors. However, Social influence and Price reflected moderately negative effects towards the acceptance of the Smartphone as a learning tool - as shown in Table 79.

Table 79: All Four Set Hypothesis Path Coefficients

Constructs	Set-I	Set-II				Set-III (Inter Contextual Moderation)										Set-IV (Intra Contextual Moderation)							
		Gen		Edu. Lev.		Context		Gender				Education Level				Gender				Education Level			
	CX	M CX	W CX	UG CX	PG CX	CX1	CX2	CX1 (M)	CX1 (W)	CX2 (M)	CX2 (W)	CX1 (U)	CX1 (P)	CX2 (U)	CX2 (P)	CX1 (M)	CX2 (M)	CX1 (W)	CX2 (W)	CX1 (U)	CX2 (U)	CX1 (P)	CX2 (P)
BIN PE	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
BIN EE	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
BIN SI	(S)	(S)	(S)	(S)	(S)	(NS)	(S)	(NS)	(NS)	(S)	(S)	(NS)	(NS)	(S)	(S)	(NS)	(S)	(NS)	(S)	(NS)	(S)	(NS)	(S)
BIN FC	S	S	NS	S	S	S	NS	S	NS	NS	NS	S	S	NS	NS	S	NS	NS	NS	S	NS	S	NS
BIN HM	S	NS	S	S	S	NS	S	NS	NS	NS	S	NS	S	S	NS	NS	NS	NS	S	NS	S	S	NS
BIN PR	(NS)	(S)	NS	(NS)	(NS)	(NS)	(NS)	(S)	NS	(S)	(NS)	(NS)	(NS)	(NS)	(NS)	(S)	(S)	NS	(NS)	(NS)	(NS)	(NS)	(NS)
BIN HA	N	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

S: Significant, (S): Negettive Significant, (NS): Negative Significant, NA: Not Available

6.4.1 Comparison of Men and Women Across Both Contexts

For the first three constructs, the combined response from the Men (from both contexts as well as individual contexts) reveals a near consensus with the combined response from the Women (from both contexts as well as individual contexts). Performance expectancy, effort expectancy and social influence were the constructs that were accorded similar responses by the Men and the Women from both contexts, as shown in Table 80.

The response to the rest of the constructs reveals that facilitating conditions were more significant for Men, while not significant for Women. Similarly, the response to hedonic motivation was more significant for Women than it was for Men. The total response by Men towards price was negatively significant, while the Women's response to price was not significant.

Table 80: CX1 and CX2 Man and Women Gender Path Coefficients

	Gender					
	CX (Men)	CX1 (Men)	CX2 (Men)	CX (Women)	CX1 (Women)	CX2 (Women)
BIN PE	S	S	S	S	S	S
BIN EE	S	S	S	S	S	S
BIN SI	(S)	(NS)	(S)	(S)	(NS)	(S)
BIN FC	S	S	NS	NS	NS	NS
BIN HM	NS	NS	NS	S	NS	S
BIN PR	(S)	(S)	(S)	NS	NS	(NS)
BIN HA	NA	NA	NA	NA	NA	NA

S: Significant, (S) Negettive Significant, (NS)Negative Significant, NA Not Available

6.4.2 Comparison of UG and PG Across Both Contexts

This thesis also provides a comparison of undergraduates and postgraduates across both contexts: The response from each of the combined contexts as well as from each of the individual contexts for both the undergraduates as well as the postgraduates revealed a near consensus for all of the constructs. Performance expectancy and effort expectancy were highly significant for both undergraduates and postgraduates. The response to questions of social influence were not significant as shown in Table 81.

Table 81: CX1 and CX2 UG and PG Education Path Coefficients

	Educational Level					
	CX (UG)	CX1 (UG)	CX2 (UG)	CX (PG)	CX1 (PG)	CX2 (PG)
BIN PE	S	S	S	S	S	S
BIN EE	S	S	S	S	S	S
BIN SI	(S)	(NS)	(S)	(S)	(NS)	(S)
BIN FC	S	S	NS	S	S	NS
BIN HM	S	NS	S	S	S	NS
BIN PR	(NS)	(NS)	(NS)	(NS)	(NS)	(NS)
BIN HA	NA	NA	NA	NA	NA	NA

S: Significant, (S) Negettive Significant, (NS)Negative Significant, NA Not Available

The response to facilitating conditions and hedonic motivation were, again, mostly significant. Price was non-significant for both. The pattern displayed in these responses was similar to each other, except for hedonic motivation, where CX2 undergraduates displayed a significant response while the CX1 undergraduates displayed a non-significant response. CX1 postgraduates provided a significant response to hedonic motivation while CX2 postgraduates did not express a desire for hedonic motivation.

6.4.3 CX1 and CX2 Comparison. The analysis revealed that both CX1 and CX2 students generally believed that using Smartphones for education would facilitate their learning, increase their academic productivity as well as help them gain higher scores. It also showed that both CX1 and CX2 students found using Smartphones for education effortless. CX1 students did not give a significant response to the queries posed by social influence, which in conjunction with their highly positive response to performance expectancy and effort expectancy shows that they did not seem to require any support in their use of Smartphones for education.

CX2 students believed that the use of Smartphones for education was not supported by their faculty and peers. The response from CX2, when seen in conjunction with their previous responses, also shows that CX2 students desired a more supportive environment for the use of Smartphones in education. Most CX1 students believed that using Smartphones in education helped them to collaborate with their classmates. CX2 students did show any significant response to this query. Again, when seen in conjunction with the previous responses by CX2, it is clear that there is a need for an inclusive mobile learning program that instructs students on the benefits of using Smartphones for educational purposes.

CX1 students did not attribute much importance to the gratification obtained through using Smartphones for education. In contrast, most of the CX2 students thought the use of Smartphones for education was exciting and fun. Interestingly, only the Men from both contexts considered Smartphones as unreasonably priced despite their educational value. But this was a minor response when examined against the majority of both the contexts where it was considered non-significant.

6.5 Conclusion Summary

The results of this research can be categorized around four points that answer the research questions.

6.5.1 Research Question 1: Significance of UTAUT2 Constructs

Is there any significance of the seven UTUAT2 constructs on behaviour intention (BI) to accept Smartphones as mobile learning tools?

The five out of seven constructs hypothesized in the Unified Theory of Acceptance and Use of Technology 2 model are supported by this study. Hence the UTAUT2 model constructs were confirmed to be significant predictors of Smartphone technology acceptance.

6.5.2 Research Question 2: Significance of Gender and Educational Level Moderators

How does Smartphone acceptance compare with gender as moderator on the total population?

d. Gender CX1+CX2 (M:W): The role of gender was found to have a strong moderating effect on the behaviour intention of using the Smartphone as a mobile learning tool.
e. Educational Level CX1(UG:PG):CX2(UG:PG): Educational level did not moderate the use of Smartphone for education.

6.5.3 Research Question 3: Significance of Inter Contextual Moderation

How does Smartphone acceptance compare across the two contexts of this study with gender and educational level as moderators?

a. Context (CX1:CX2): the effect of context was moderate
b. CX1(M:W) :CX2(M:W) The effect of Inter contextual comparison of undergraduate and postgraduates students showed significant differences.
c. CX1(UG:PG) and CX2 (UG:PG) showed negligible differences in their opinion to use Smartphones as mobile learning tools.

6.5.4 Research Question 4: Significance of Intra Contextual Moderation

How does Smartphone acceptance compare across the two contexts for the same gender and the same education level moderator groups?

The fourth and final set of research questions was designed to examine the effect of Intra contextual comparisons of gender and undergraduate moderators.

a. **Gender**
   i. CX1(M):CX2(M): The first set compared the Men's responses in both contexts and the result reflected significant differences in their opinions.
   ii. CX1(W):CX2(W) In contrast, the Women gender Intra group comparison reflected very negligible differences. Only price value constructions differed between the two groups of Women**.**

b. **Educational Level:**
   i. CX1(UG):CX2(UG): A comparison of the undergraduate Intra group found facilitating conditions and hedonic motivation to partially moderate the group effect .
   ii. CX1(PG):CX2(PG): Intra contextual postgraduate comparison only reflected facilitating conditions as the major difference of opinion.

To conclude, UTAUT2 is a useful model to predict the use of Smartphones as mobile learning tools. Gender was a strong moderator followed by the context which is a significant moderator. At the same time, the educational level was not a significant moderator in predicting behaviour intention to use Smartphones as mobile learning tools. Lastly, the inter and intra context moderation proved significant by this research. The next chapter of this research will present a detailed discussion concerning the outcome of these hypotheses. It will also look into the implications of the findings of this research and subsequently conclude with suggestions for future research.

Chapter 7

7.0 Research Contribution and Future Studies

7.1 Introduction

The aim of this chapter is to discuss research significance and implications of the findings of this research. It reiterates the theories that underpinned this research study, as outlined in the literature review. The chapter concludes with an examination of the study's implications, while outlining the potential areas of investigation as well as its possible limitations.

This research contributes to the body of knowledge surrounding mobile learning and the use of Smartphones as mobile learning tools. As discussed in the methodology chapter, this research intends to make a significant contribution in the field of higher education as it has measured the contextual acceptance of the use of Smartphones as a learning tool by University students. This acceptance of the Smartphone as a learning tool was measured using the Unified Theory of Acceptance and the Use of Technology (UTAUT2) model (Venkatesh et al., 2012).

7.2 Research Contribution

This thesis contributes to existing bodies of knowledge by providing information about the acceptance of Smartphone-based mobile learning. The following list highlights the significant contributions to knowledge made by this research:

1. Significant Smartphone acceptance parameters were identified
2. A better predictability of the Smartphone acceptance model was established
3. The significance of Educational Context in Smartphone acceptance was identified
4. Significant constructs that infuse Smartphone acceptance were identified
5. Significant Moderators that influence Smartphone acceptance were identified
6. A Deeper understanding of moderator subgroups in Smartphone acceptance was developed

This research study extends theoretical studies in the field of technology acceptance. The statistical analysis technique presented in this thesis has provided new ways (by comparing Inter and Intra moderator groups) of looking at the acceptance of Smartphone technologies in university education. The significant achievements are further discussed in length in the remaining part of this section

7.2.1 UTAUT2 Model Significance

This thesis has examined the feasibility of the UTAUT2 model by testing it in a university setting. This thesis has extended the original UTAUT2 model by modifying the existing constructs and introducing new moderators in order to investigate the use of Smartphones by students and their willingness to accept them as learning tools. It is one of the first studies to use this model to investigate Smartphone use in a university setting to compare the intention of using the Smartphone as a mobile learning tool. Consequently it could provide a foundation for future research in this area.

7.2.2 Context Comparison:

The comparison of two educational contexts increases our understanding of technology integration. The contextual comparison has revealed that when it comes to accepting technology, different colleges accept educational technology differently. To this researcher's knowledge, such a comparison has not been attempted before in a technology acceptance study. Contextual comparisons (multiple groups such as age, gender, educational context) provide an in-depth knowledge into the use of Smartphones in different environments. The comparative analysis of these two contexts can be compared to similar academic cohorts so as to assess the parameters that drive the acceptance of Smartphones in a university setting.

A major contribution of this study was to confirm the influence of context as a moderator in the adaptation of the Smartphone as a mobile learning tool. Context in academic settings has three different connotations (Wu et al., 2008). First, the same context in academia refers to a group of students who are educated in the same body of knowledge. Second, the context can refer to the geographical location or distinctive space, and finally the third connotation of context in mobile devices is also in reference to the Smartphone screen size, computing power and operating system. This research recognises the first meaning of context and hence differentiates the two groups from the College of Engineering as (CX1) and the College of Education as (CX2).

Different academic contexts offer opportunities to exploit environment, curriculum, program, content, student communication and interaction; this is due to the differences in learning settings. These dynamics compel mobile learning content developers to design new classes of learning content, mobile applications, multimedia and assessment methods. This study plays the role of a stepping stone by establishing the significance of academic context as important criteria for future mobile learning environments, wearable devices and Context-aware cognitive computing in education.

Historically, text books and other printed learning material were designed with the assumption that all learners were analogous and they learnt with the same learning styles. With the advent of e-Learning technologies, this notion changed and learning content was designed with voiceovers, multimedia and interactivities that catered to diverse learning styles. These e-learning contents were delivered on technologies such as computers and laptops. Unlike their predecessors, Smartphone mobile technologies can be personalized, customised and contextualized; this in turn demands yet another rethinking in designing learning content.

Smartphone-based mobile technologies are a convergence of many technologies such as phones, cameras, geographical positioning systems, inbuilt sensors, media players, wireless file sharing, computing, etc. (Kearney, Schuck, Burden, & Aubusson, 2012) posits that this unification of a large number of technologies into Smartphones offers a variety of possibilities to use for context-based learning content design, as shown in Table 82.

Table 82: Smartphone features offered for contextual learning environments

Smartphone Technology	Contextual Learning Opportunities
Personal	gives customisable autonomy
User centred	caters to personal learning style and pace
Mobility	gives learning anytime anywhere flexibility
Network	aids in creating collaborative environment
Ubiquitous	available with every learner
Durable	for formal, informal and lifelong learning
Applications and Sensors	provides immense productivity tools and aids

Source: adopted from Kearney et al. (2012)

7.2.3 New Constructs

This study redefines the two original UTAUT2 constructs, Social influence and Facilitating conditions in order to maintain relevance in this study's scope of research, as explained in the Methodology chapter of this research. The Social influence construct was redefined to represent the social connections of a typical student with his or her peers, classmates and teaching faculty. These three groups of people are expected to constitute the social support for a student using Smartphones for education. Social influence originally was assumed as the influence of family and friends in the UTAUT2 model.

The second construct, Facilitating conditions, was also redefined as the receiving of educational support through Smartphone connections and communication. The original construct 'Facilitating Conditions' of the UTAUT2 model defines them as the receiving of technical support, suitable infrastructure, a provision of help-desks, software and hardware support. In the case of Smartphones, these Facilitating conditions have little or no meaning as Smartphones are self-owned and come preinstalled with software and applications. Moreover, Smartphone users are skilled in using their devices without the requirement of technical support or help. This study recognized the theory of Connectivism proposed by (Siemens, 2005) as it posits that knowledge is distributed across communication networks in digital formats. Hence the definition of the Facilitating conditions construct was effectively replaced with a new definition; that of being connected through Smartphones with friends, peers and other communities for the purpose of learning. This was influenced by the relevance of the Connectivist learning theory in the era of digital communication devices.

7.2.4 Incorporating New Moderators

Educational Context: This study utilised a new set of moderators, context and education level. The findings highlight the various factors which enable or inhibit the acceptance of Smartphone-based learning in a university environment. This thesis examined two different contexts within a single university: an engineering college (CX1) and a college of education (CX2). This thesis outlines key differences in their programs, curriculums, teaching pedagogies, student aptitudes, required skills and length of studies.

Educational Level: This study employed Educational level as a new moderator replacing Age in the UTUAT2 model. This was done after conducting the literature review where this study discovered that the Educational level (of the respondent) was a better moderator than Age.

7.2.5 Inter and Intra moderator comparison technique

This study used a technique of group comparison along the parameters of the various Inter and Intra moderators. These multilevel moderator comparisons helped in assessing the effect of moderators (gender, context and educational level) which was principal to this research. This innovative technique aided in a much deeper understanding of the moderators with regards to their effects, intensities and significance levels. The results revealed that the Inter and Intra group comparison of moderators could be key to understanding the behavioural intention in accepting the Smartphone as a learning tool. This technique is expected to set precedence in technology acceptance studies for future mobile and other such evolving technologies.

7.2.6 New Zealand Context

The findings of this research are very relevant to the New Zealand context. This study will help universities, and similar institutions, to create customized programs to ensure successful integration of Smartphone technology in universities in New Zealand and hopefully further abroad.

7.2.7 Meta-Analysis for selection of research methodology, tools and techniques

Meta analyses in this research summarised and reviewed selective quantitative research of technology acceptance conducted in the fields of mobile learning. This thesis used the systematic review of literature/meta-analysis method which was not attempted before by any research which studied Smartphone technology acceptance. This technique also helps identify population sample selection, instrument adoption, the software/tools and statistical techniques utilised by these studies. This thesis therefore provides a model for those wanting to conduct similar projects; it can be used to help select appropriate research methodologies, survey instruments and software applications.

7.3 Research Implications

The research findings presented here have several potential academic, strategic, managerial and pedagogical implications. First, the technology acceptance model used in this research (UTAUT2 model) can be applied to both western and non-western countries with an ability to be generalised with varying degrees of explanatory power. The instrument used was empirically validated using the best set factor extraction technique, data clustering, validating and reliability testing methods.

This study will aid educators, academics and researchers in identifying the key components of technology acceptance. The dependent variable used in this research model was behavioural intention and the independent variables were Performance expectancy, Effort expectancy, Social influence, Facilitating conditions, Hedonic motivation and Price. Both Performance expectancy and Effort expectancy were unanimously seen by both contexts and moderators to be key components of behavioural intent. Social influence, facilitating conditions and hedonic motivation do not appear to affect behavioural intention. However, these factors are shown to have a different impact upon each of the social groups and therefore should also be considered as they define the fine line of acceptance of technology.

The group difference hypothesis results provide a foundation to better understand the integration of Smartphones for academic institutions, educators, instructional designers and decision makers as well as the factors which aid the implementation of the Smartphone as a learning tool. This research provides stakeholders with vital information relating to mobile learning acceptance and thus will enable them to incorporate these factors in design and implementation phases.

This research study has potential implications for the successful integration, design and implementation of Smartphones as mobile learning tools in a university context. This thesis was based on the fact that the usability of Smartphones is highly contextual and personalised. Hence the methodology adopted was designed to compare the behaviour intention of two colleges as the context population sample. This study also sought to examine the effect of gender and education as moderators in the field of higher education.

7.3.1 Potential Implications for University Education

Five out of seven UTAUT2 constructs came out significant in assessing the behaviour intention to use the Smartphone as a learning tool. With this outcome this research has demonstrated that the UTAUT2 technology model is effective in assessing the behaviour intention of using Smartphones as learning tools, within the two contexts within a university environment. The research also provided a theoretical understanding of the parameters, constructs and moderators which affect the acceptance of this technology. This research provides an in-depth understanding of the role of educational context in conjunction with gender and educational levels with both Inter and Intra relationships, in a university setting.

Much of the previous research has used the Technology Acceptance Model (TAM's) and the Unified Theory of Acceptance and Use of Technology but fell short of addressing the complex parameters of assessing integration of mobile technologies and their contextual integration. These models were developed for generic technology acceptance assessment and thus are not successful in testing the Smartphone's viability in different contexts. This thesis assesses the acceptance of the Smartphone as part of a learning technology using the UTAUT2 model. It argues that the current research contributes to the existing literature by providing a new perspective to the UTAUT2 by developing innovative methods of Inter and Intra moderation comparisons.

7.3.2 Smartphone-based Mobile Learning

The results of this research prove that students from both contexts believe that using Smartphones will benefit them by improving their academic performance. These results suggest that Smartphones should be included as learning tools in educational facilities. Adhikari, Mathrani, and Parsons (2016) suggest that with the rapid diffusion of digital devices in everyone's daily life the demand of being digitally literate has also increased. Mobile learning facilitates personalised learning, contextual learning, learner centred learning, situated learning, collaborative learning, ubiquitous learning, lifelong learning, just-in-time learning, micro-learning, rich media learning, interactive and immersive learning, synchronous learning and asynchronous learning.

Understanding the use of Smartphone devices as opposed to desktops, will enable educators to better integrate this technology. This study will benefit universities, educational content developers, and government-run educational institutions to understand the revolutionary features and sensors that leverage the use of Smartphones for learning. The other highly beneficial features include access to the internet for research, access to e-mail, taking a picture of the day's homework assignment scribbled on the whiteboard or taking a short video of a key lecture moment. Smartphones can be used for taking real-time lecture notes, as student response systems, for recording lectures with voice memos, or for using QR codes to find relevant websites with a simple click. They can also be converted into classroom "clickers," and used to keep track of one's schedule. The aforementioned benefits can be used to revolutionise education.

7.3.3 Wearables Devices and Next Generation Smartphones

Smartphones are increasingly integrated with wearable devices. Wearables are smart wearable technologies which are paired with Smartphones to communicate with sensors, so as to enable the exchange of data. These devices are usually worn as wristwatches, arm bands, or eye glasses. They are usually paired with Smartphones, which in turn aid and facilitate users to interact hands-free.

Wearables provide access to information and data in real time, appropriate to the specific context. A clear understanding of Smartphone integration can provide successful and seamless integration of future technologies. It is estimated that by 2020 there will be 12 billion integrated devices, contributing to a network described as the "Internet of Things". The explosion of such connectivity will offer exponential capabilities for both learners and educational institutions. The findings of this research can act as blueprints or guidelines for exploring and conducting future research for future emerging educational technologies. The next generation of Smartphones may in fact become wearables themselves. Thus, the findings of this thesis can also be extended to assess the integration of wearables for academic use.

7.3.4 The New Zealand Advantage

Smartphone ownership rose to more than two billion devices by 2015. In short, one in three individuals worldwide will own a Smartphone. The same research found that there are 800,000 Smartphone applications available for Apple iPhone and 700,000 for android-based operating systems (Van der Wee & Beltrán, 2015). According to a recent study an estimated 70% of adults in New Zealand own Smartphones (Media, 2014). In his study, Sullivan (2013) estimates that 90% of New Zealanders will own a Smartphone by 2018. The New Zealand government plans to make ultrafast wireless broadband available to 97.7 % of schools and 99.9 percent of students by 2016 (Van der Wee & Beltrán, 2015). This thesis is of vital importance given the expected rise in Smartphone ownership in New Zealand, thus the findings of this research can aid the understanding of Smartphone integration in the context of New Zealand tertiary education.

7.3.5 Bring Your Own Device (BYOD)

The unanimous acceptance of effort expectancy indicates that the use of Smartphones can provide easy access to learning at any place and time, which is obviously convenient for learners. Academic institutes need not invest hefty budgets in purchasing devices. The

97% penetration and use of this device which is steadily replacing the personal computer will change the nature of education and learning. The findings of this study provide insights into the levels of Smartphone integration for informal and formal learning.

7.3.6 Contextual Learning

Smartphones take their cues from user data and the individual’s environment and interaction with an operating system. Smartphones can respond to learners’ needs. The integrated GPS sensors, accelerometers and gyroscopes, all enable Smartphones to capture and utilize sensor data to enrich a learner’s experience. Many popular content providers like Google, Wikipedia and popular online learning repositories currently combine user data with their location to provide information of contextual relevance. Location data allows for contextual awareness to determine usability, privacy and just in time content.

Smartphones with the latest sensors have the ability to estimate a learner’s next action and monitor their progress as would a personal assistant. Smartphones can augment customized commands, remember places and services, and offer functions which match a learner’s location and schedule.

7.3.7 Connectivism

Siemens (2004), theorised that learning is created by forming networks of connection. The principles of connectivism also state that learning is a process of connecting specialised nodes and sources of information. A learner’s urge to seek more knowledge is more important than what he or she currently knows. The driving force of connectivism is the intention of gaining knowledge or information which is current (Siemens, 2014). Connectivist theory (Prensky, 2001) has become increasingly common, since the 1980s, with the rise of digital technologies. Children born during this time are often referrred to as “digital natives”. Understating how “digital natives” communicate using Smartphones is crucial in order to design programmes which effectively meet their needs.

Danaher, Moriarty, and Danaher (2009) stress the importance of engaging learning communities with learning technologies. The new facilitating conditions construct which was based on Connectivism theory proves to be a significant predictor in this research of a student's intention to use smartphones for learning.

7.4 Suggestions for Future Research

Although there are many fields which explored technology acceptance, research in the area of acceptance of Smartphones for mobile learning is relatively unexplored. More research is needed to expand the knowledge in this area. As a new field, technology acceptance provides numerous avenues of research.

7.4.1 Study Replication

This thesis only examined students studying engineering or education, in one university. Later studies could replicate this research in different contexts of academia by examining the data collected similar to that of this study. As evident from the results of this research, colleges that differ in their academic contexts also differ in their acceptance of Smartphone technologies in education. Cochrane (2014) claims that most of the research conducted in the fields of mobile learning have focused on using them for communication, information search or receiving learning content. Hence there is a need to conduct longitudinal studies across multiple contexts.

7.4.2 Effort Expectancy

Further investigation of the relationship between the effort expectancy and behaviour intention constructs is suggested by this research. Xu (2014) argues that effort expectancy explains the perceived ease of using any technology. This thesis has confirmed the finding of Yoon and Kim (2007) that when any technology is successfully integrated into the mainstream, the user's perception of that technology's ease of use tends to diminish in the presence of behaviour intention construct.

This thesis argues that the effort expectancy construct tends to lose its influence on behaviour intention to use any technology when users have acquired experience through continued use. Hackbarth et al. (2003) note that when a user spends considerable time on a device he or she develops expertise in using it. In the presence of performance expectancy, the effect of effort expectancy tends to diminish. Kumar and Owston (2016) claim that there are few research studies available which tested the usability of higher education e-learning content. This thesis therefore suggests that effort expectancy should be replaced with user experience and usability as a main construct.

New research, therefore, should assess the usability of the Smartphone as a learning device by focusing on learners' interactions with the Smartphone. For example, screen size may be included in future questionnaires to assess usability. Likewise, questions about user interface should be tested for their appropriateness in determining an individual's views about usability.

7.4.3 Social Influence

The social influence construct of the UTAT2 model is defined as the influence by peers and friends on the student within the local area in which he operates. Future research should investigate the influence of social media as part of social influence . One approach could be to extend the social influence construct into a second order factor as in the model illustrated in Figure 27. Previous research has argued that social influence diminishes over time with the widespread use of a technology (Margaryan et al., 2011). Given this, future research investigating social influence on Smartphone use should incorporate a longitudinal design in order to show changes in the new two factors of social influence as proposed. Since there is almost no research which examines students' acceptance of technology over time in relation to the influence of faculty and peers, more longitudinal and panel studies are needed.

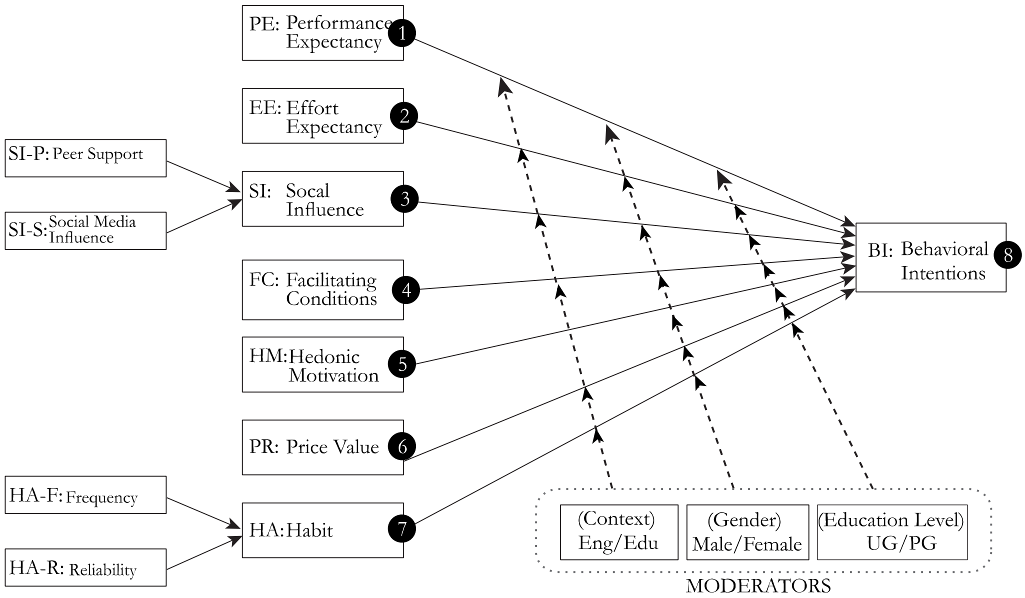

Figure 26: Proposed Future Study Second Order Structural Equation Model

7.4.4 Habit

Habit does not seem to play an essential mediating role in self-motivated environments, such as under conditions of frequent and informal use. As noted earlier, habitual behaviours are not accentuated in the involuntary use of technology. Wilson et al. (2010) suggest that habit plays a secondary role in predicting continued frequency of use. Prior studies have found the influences of habit are often reinforced when they are acquired from repetitive behaviours (Venkatesh & Davis, 2000). Habit is formed with strong relationships between prior mandated use frequency which in turn reinforces this attitude towards evident behaviour and/or the circumstances in which this behaviour occurs (Kim, Malhotra, & Narasimhan, 2005).

Future research could consider the importance of the habit construct by studying contexts where the use of technology is not mandatory, as in the self-motivated environments discussed above. For example, the frequency of use may be dependent on the content authenticity and the reliability of the learning material used in the education context. Wilson et al. (2010) confirm that habits relating to the use of information technology begin to form during the mandated initial use cycle. Exploring the habitual strength under conditions where the use of technology is not mandatory may increase our understanding of the influence of habit on behaviour intention.

7.4.5 Price

This thesis found that price is insignificant to most of the moderator groups assessed in this research. This thesis argues that the price value or ownership of a Smartphone is mainly related to its use. This usage involves daily communication, entertainment, internet access and other activities aside from using the device for education and learning. Furthermore, the Smartphone is also used for its productivity tools such as its camera, alarm clock, calendar etc. The student does not solely associate the Smartphone's price value in terms of its educational advantages. Further investigations into the direct cost of Smartphone-based mobile learning services provided by universities, educational institutions or third party providers could be studied under the price construct. Additional studies can also investigate the level of cost that students are willing to pay for rich, current and updated material.

7.4.6 Contextual Comparisons

Future studies could assess the contextual comparison of technology acceptance even deeper by delving into the subgroups of each context. For example there are many branches in the College of Engineering (civil, mechanical, electrical and chemical engineering, for example). Future studies can compare and contrast these sub levels and assess the group differences or similarities of using Smartphones as mobile learning tools. This thesis confirms that there is a statistical difference between the two groups – the engineering students and the education students - in terms of their intention to use Smartphones as learning tools. Such assessments are expected to give a deeper understanding of the learner's acceptance of Smartphones which can aid in a successful integration of the intended technology.

7.4.7 New Constructs

The ongoing evolution and advancement of Smartphone technologies, with newer and more advanced features, demands ever more research on newer moderators for determining the usage behaviour in discretionary contexts. Further investigation is also needed with respect to the range of new emerging factors when examining technology acceptance behaviour. With the rampant increase in communication methods, tools and techniques, the current generation of users are highly connected. Kittl, Edegger, and Petrovic (2009) posit that today's younger generation uses mobile phones as their principal communication device and hence they can justly be used as innovative learning tools. Thus future studies can assess the effect of communication mediums as a new construct on the acceptance of Smartphones for education. To date, most research conducted in the fields of technology acceptance have been focused on older subjects or the workplace. It is crucial to conduct further research with younger users, as this will provide vital information about how best to successfully integrate Smartphone technologies.

7.4.8 New Moderators, Educational Level

Age as a moderator was replaced with educational level to investigate the acceptance of Smartphone-based mobile learning. However, this thesis did not find significant effects of educational level (as a moderator) among the undergraduate and postgraduate groups on their behaviour intention of using Smartphones for education. Since previous studies have shown a relationship between age and technology acceptance (Venkatesh et al., 2003), it would be valuable to investigate the effect on sophomore, junior, senior and graduate student levels.

APPENDIX A: Meta-analysis articles results

1-DESCRIPTIVE INFORMATION						2-STAT. POWER			3-SOFTWAR		4-MODEL		5-MODERATORS			6-DATA ANALYSIS TECH.						
No	Author	Year	Technology	Region	Mobile Tech.	Sample	Constructs	Items	Software	Pilot	UTAUT	UTAUT2	Gender	Age	Other	Descriptive	EFA	Scale Evaluation	CFA	t-Test	ANOVA	Regression
1	Segura et al.,	2015	Pervasive Infformation Systems	Germany		346	6		S-A			X	X	X		X		X	X			
2	Huang et al.,	2015	Phablets	Taiwan	X	266	9					X	X	X	X							
3	Estorninho,	2014	Mobile Hospitality	Portugal	X	348	9	32	P	X		X	X	X	X	X	X	X	X			
4	S Pheerap et. All.,	2014	Smartphone	UK	X	160	8	27	P		X		X	X		X	X	X	X			
5	Oechslein et al.,	2014	Social Networking	Germany	X	266	8	22	P			X					X	X		X		X
6	Harsono et al.,	2014	Social Media	Indonesia		419	9		P	X		X				X						X
7	Leong et. All.,	2013	NFC	Malaysia	X	265	7	23	S	X	X		X	X	X	X		X	X			
8	Abu-Al-Aish et. Al.,	2013	Mobile Learning	UK	X	174	6	23	S		X		X	X	X	X	X	X	X			
9	Yang S.,	2013	M-Learning	China	X	182	8	25	P	X		X	X	X	X	X		X	X			
10	Martins,	2013	Online Music Service	Spain		329	11	37	P	X		X	X	X		X		X				X
11	Yang,	2013	Mobile Learning	China	X	182	7	22	P	X		X				X	X	X	X			
12	Raman et. All.,	2013	LMS	Malaysia		320	8	27	P			X				X		X	X			
14	Admiraal et. All.	2013	Technology	Netherland		111	4	21				X	X	X	X	X						X
15	Jambulingam,	2013	Mobile Learning	Malysia	X	351	6	20	A		X		X	X				X	X			
16	Alalwan et al.,	2013	Mobile Banking	Jordan	X	344	6	32	A			X				X	X	X	X			
17	Slade et. All.,	2013	Mobile Payment	UK	X		7	43				X	X	X		X		X				
18	Almatari et. All.	2013	Mobile Learning	Malaysia	X	0	7	0	S		X		X	X	X							
19	Fehrenbacher D.,	2013	Online Banking	Australia		0	8		S	X		X				X						
20	M.-Y. Wu et al.,	2012	Smart Card	Taiwan	X	201	6	18	L		X		X	X	X	X		X	X	X	X	
21	Chain Yu,	2012	Mobile banking	Brazil	X	441	8	30	S		X		X	X		X	X	X	2			
22	Abdulwahab et al.,	2012	Telecom	Nigeria		191	9	30	A		X		X	X	X		X	X				X
23	Yu,	2012	Mobile banking	Taiwan	X	441	8	32	S		X		X	X		X	X	X				X
24	Williams et al.,	2012	Technology	Australia		300	6	24	S		X					X	X	X	X			
25	Nassuora,	2012	Mobile Learning	Saudi Arabia	X	80	6	18	S		X					X	X					X
26	Alrawesh et. All.,	2012	WBT	Jordan		290	8	24	A		X							X	X			
27	Wong et. All.,	2012	Computer	Malysia		245	4	14	A		X					X		X	X			
28	Seppo et. all.,	2011	eBay	China		180	8	43	S		X		X	X		X	X	X				
29	Dong-Hee et. All.,	2011	Smartphone	South Korea	X	215	9				X		X	X		X	X	X	X			
30	Pitchsys..,	2011	Smartphone	Thailand	X	204	5	24			X		X	X	X	X		X	X			
31	Zhang et al.,	2010	Mobile Search	China	X		5	16	P		X		X		X	X	X	X	X			
32	Moran et al.,	2010	Mobile Computing	USA	X	263	9	35	P		X		X		X	X		X		X		X
33	Adell E.,	2010	Driver Support System	Sweden		20	4	19		X	X		X	X	X	X						X
34	Sundaravej,	2010	Model Validation	USA		262	8	32	A		X		X	X	X	X	X					
35	Raman et. All.,	2010	ICT	USA		320	8	27	P		X					X	X	X			X	X
36	Wilson et. All.,	2010	ICT	USA		213	8	27	P	X			X	X		X		X	X		X	X
37	Chen et al.,	2009	Smartphone	Taiwan	X	274	12						X	X	X	X	X	X	X			
38	Wang et. All.,	2009	Mobile Learning	China	X	330	4	21	A		X					X	X	X	X			
39	Jairak et al.,	2009	Mobile Learning	Bankok	X	390	6	23	S		X		X	X	X	X						X
42	Y.-L. Wu et al.,	2008	3G Mobile	Taiwan	X	394	6	29	S-A		X		X	X	X	X	X	X	X			
44	Liu,	2008	Mobile Learning	Finland	X		9	0			X		X	X	X							
45	Bandyopadhyay et al.,	2007	ICT	USA		502	3	14	A		X		X	X	X	X		X	X			
46	Weiwei SHI,	2007	Infomediaries	China	X	650	6	27	S		X					X	X	X		X		
48	Carlsson et al.,	2006	Mobile Technology	EU	X	157	6	48			X		X	X	X	X	X		X			X
49	Chesney T.,	2006	Games	UK		170	5	15	S													X
									AVERAGE	20%	64%	30%	68%	64%	45%	82%	48%	73%	52%	9%	7%	32%

APPENDIX B: Meta-Analysis, Scale Evaluation

S No.	Research	Usability		Reliability			Validity				
									Construct Validity		
		Content Design	Visual Design	Test-Retest Reliability	Alternate Forms Reliability	Internal Consistency C-Alpha	Content Validity	Criterion Validity	Convergent	Discriminant	Nomological
1	Pahnila et al., 2011					x	x		x	x	
2	Xu, 2014					x	x		x	x	
3	Yang, 2013					x	x		x	x	
4	Raman et al., 2013					x			x	x	
5	Raman & Don, 2013			x		x	x		x	x	
6	Alrawashdeh et al., 2012					x					
7	Pheeraphuttharangkoon et al., 2014					x				x	
8	Shin et al., 2011					x					x
9	Luan et al., 2008										
10	Yu, 2012					x					
11	Wang et al., 2009					x	x		x	x	
12	Jairak et al., 2009					x	x				
13	Venkatesh et al., 2012								x	x	
14	Park et al., 2012						x				
15	Admiraal et al., 2013								x		
16	Raman & Don, 2013					x			x	x	
17	Admiraal et al., 2013					x	x		x	x	
18	Chesney, 2006					x					
19	Fehrenbacher, 2013						x		x		
20	Leong et al., 2013			x		x	x		x	x	
21	Leong et al., 2013										
22	Abu-Al-Aish et al., 2013					x			x	x	
23	Oshlyansky et al., 2007										
24	Adell, 2010						x				
25	Oshlyansky et al., 2007										
26	Jairak et al., 2009					x					
27	Sundaravej, 2010					x			x	x	
28	Bandyopadhyay et al., 2007						x		x	x	
29	Jambulingam, 2013					x			x	x	
30	Moran et al., 2010					x			x	x	
31	Yu, 2012					x			x	x	
32	Martins, 2013					x	x		x	x	
33	Wang et al., 2009					x			x	x	
34	Nassuora, 2012					x					
35	Carlsson et al., 2006					x					
36	Williams et al., 2012										
37	Y.-L. Wu et al., 2008					x					
38	Weiwei SHI, 2007					x			x		
39	Liu, 2008					x					
40	Lederer et al., 2000					x	x				
41	Chen et al., 2009					x			x	x	
42	M.-Y. Wu et al., 2012	x				x					
43	Abdulwahab et al., 2012					x	x		x	x	
	TOTAL	**1**	**0**	**2**	**0**	**33**	**16**	**0**	**24**	**22**	**1**

APPENDIX C: Pre-Pilot Survey Instrument

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Date:

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Information Sheet for Students

I am a Ph.D. candidate at the College of Education, University of Canterbury, New Zealand. I am doing my PhD research under Dr. John Everatt and Dr. Wendy Fox Turnbull. My research aims at finding how Smartphones are accepted as a learning support tool at the university.

The main objective of this project is to find how students perceive these tools with regards to their ease of use and effectiveness as learning aid. I would like to invite you to participate in this study. In the study, I will give you a questionnaire. **You are requested to take this survey only once (either online or paper based only).**

Survey
The survey will ask your age, gender, education program, year of study and type of **Smartphone*** owned. Further the survey will also ask some background information about your experience of using smartphones usability and functionality of these devices, knowledge of using smartphone operating systems and applications and advantages or disadvantages of using these devices in education (Duration 20: Min).

These surveys can be taken either paper based, online or mobile devise. Please note that your participation in this study is voluntary. If you participate, you have the right to withdraw from the study at any time without any penalty and prior permission. If you withdraw, I promise to remove any information relating to you if this is practically possible.

I will take particular care to ensure the privacy of all the data collected for this study. The survey does not collect your identity (name, student ID, address etc.). I ensure that your identity is never be documented or disclosed. All the data will be stored in password protected facilities and locked storages at the University of Canterbury following the study. It will then be destroyed altogether after five years. The results will also be reported internationally at conferences and in journals. You may receive a brief report on findings of the study upon request.

If you have any question about the study, please contact me at the details provided above. If you have a complain about the study, you may contact the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz). You can also contact the project supervisor, Dr. John Everatt, at john.everatt@canterbury.ac.nz concerning anything with regard to this project.

If you agree to participate in the study, please fill out the Consent Form. I look forward to working with you.

Mazharuddin Syed Ahmed

** Smartphone is a mobile phone with more advanced computing capability and connectivity than basic feature phones such as a media player, digital camera, GPS navigation, touchscreen computer, web browsing, Wi-Fi, 3rd-party applications and accessories. Popular examples of Smartphone are Apple iPhone, Samsung Galaxy, Blackberry, etc.*

☐	**By checking this box, I hereby agree to participate in this study.**

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Consent Form

☐	I have read the information sheet and understand what will be required of me if I participate in this project.
☐	I have read the information letter and understand that all information collected will only be accessed by the researcher and his supervisors and that it will be kept confidential and secure for a minimum period of 5 years following completion of the project and then destroyed. I understand that the data may be used for publication.
☐	I understand that names will not be used in this research.
☐	I understand that my participation in this study is voluntary, and that if I do participate I have the right to withdraw from the study at any time without penalty. If I withdraw, the researcher will do his best to remove any information relating to me, provided this is practically achievable.
☐	I would like to receive a report of the study to be sent to me at ________________________________. (*Indicate your preferred email address*).
☐	I understand that if I have any question about the study, I can contact the researcher via the details he has provided above. If I have a complaint about the study, I may contact either or the Chair, Educational Research Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch (human-ethics@canterbury.ac.nz) or the supervisor of this research John Everett (john.everatt@canterbury.ac.nz)
☐	**By checking this box, I hereby agree to participate in this study.**

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QUESTIONNAIRE PART-I

A DEMOGRAPHIC QUESTIONS

01	Gender	◯ Female ◯ Male
02	Age (years)	◯ Below 18 ◯ 18-20 ◯ 21-25 ◯ 26-30 ◯ 31-40 ◯ Over 40
03	I am currently a student of	◯ College of Engineering ◯ College of Education
04	I am currently enrolled in	◯ Undergraduate ◯ Postgraduate ◯ Masters ◯ PhD
05	Year of Study for current program	◯ First ◯ Second ◯ Third ◯ Fourth
06	I own a Smartphone/Tablet	◯ Smartphone ◯ Tablet (iPad etc.) ◯ Both ◯ None
07	My Smartphone Operating System is	◯ Android ◯ Apple iOS ◯ WinOS ◯ Other
08	My skill in using Smartphone is	◯ Expert User ◯ Good User ◯ Limited User
09	My choice device for education	◯ Smartphone ◯ Tablet ◯ Both ◯ None
10	I am aware of the following FREE online learning resources	◯ Open Courseware (OCW) ◯ Open Education Resources (OER) ◯ MIT Open Education Resources ◯ Khan Academy ◯ Coursera ◯ Massive Open Online Courses (MOOCs) ◯ Udacity ◯ None

B How much do you agree in using your **Smartphone for University Education** for the following **REASONS**

01	Using educational mobile applications →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
02	Taking educational notes →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
03	Reading, refer eBooks, research articles etc. →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
04	Using educational resources →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
05	Searching for educational resources on Internet →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
06	Viewing video or audio recorded lectures →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
07	Conducting laboratory work/experiments →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
08	Taking quiz, surveys and polling →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
09	Submitting homework and assignments →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
10	Asking lecturer questions after class hours →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
11	Communicating with peers/friends for learning →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
12	Using Social Networking for learning →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
13	Collaborating with online communities for learning →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree
14	Collaborating with University faculty →	◯ Strongly Agree ◯ Agree ◯ Neutral ◯ Disagree ◯ Strongly Disagree

C How often do you use **Smartphone** for the following activities

01	Playing Games →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
02	Listening to Music →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
03	Watching Movies →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
04	Social Networking (Facebook, Twitter etc.) →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
05	Online Banking →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
06	Online Shopping →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
07	Read News →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
08	Reading Books, Magazines etc. →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
09	Distributing Files →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never
10	Downloading Files →	◯ Very Often ◯ Often ◯ Sometimes ◯ Rarely ◯ Never

QUESTIONNAIRE PART-II

A How do you rate the use of your **Smartphone in University Education** for the following **REASONS**

No.	Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
01	I plan to use Smartphone for education	○	○	○	○	○
02	I find my Smartphone easy to use	○	○	○	○	○
03	Staying connected with classmates using Smartphone helps me access learning resources	○	○	○	○	○
04	Smartphone are reasonably priced	○	○	○	○	○
05	Online learning resources created by other Universities are reliable and dependable	○	○	○	○	○
06	Smartphone is an effective tool for using learning resources from internet	○	○	○	○	○
07	I can get help at University for using my Smartphone for education	○	○	○	○	○
08	Staying connected with peers using Smartphone helps acquiring knowledge	○	○	○	○	○
09	Owning Smartphone is a status symbol in University	○	○	○	○	○
10	People who influence my behaviour think that I should use Smartphone for education	○	○	○	○	○
11	Smartphone connects me to people which can help in my education	○	○	○	○	○
12	I anticipate that Smartphone will be an important device to use online content for education	○	○	○	○	○
13	People who are important to me think that I should use Smartphone for education	○	○	○	○	○
14	I will always try to use Smartphone for education	○	○	○	○	○
15	Smartphone connectivity builds connections needed to learning	○	○	○	○	○
16	I have the resources necessary to use my Smartphone for education	○	○	○	○	○
17	Using Smartphone for education would make my classmates think that I am knowledgeable	○	○	○	○	○
18	I am addicted to using Smartphone	○	○	○	○	○
19	Learning to use my Smartphone for my education is easy for me	○	○	○	○	○
20	My Smartphone is compatible with the University wireless network	○	○	○	○	○
21	Using Smartphone for education is enjoyable	○	○	○	○	○
22	I have the knowledge necessary to use my Smartphone for education	○	○	○	○	○
23	Leaving my Smartphone at home would force me to go back and pick itup	○	○	○	○	○
24	Smartphone will help me learn anytime anywhere	○	○	○	○	○

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25	The use of Smartphone has become a habit for me	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
26	Using Smartphone will help me do my homework	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
27	Using Smartphone for education is entertaining	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
28	I would find my Smartphone easy to use for education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
29	Using Smartphone for education is fun	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
30	People whose opinions that I value prefer that I use Smartphone for education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
31	Using Smartphone will help me get better grades	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
32	Staying connected using Smartphone helps in collaborating with my classmates for learning	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
33	Using Smartphone will help me accomplish learning more quickly	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
34	I can operate Smartphone without help	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
35	Classmates and peers in my University encourage the use of Smartphones for education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
36	My Smartphone Synchronises with desktop computer or laptop I use	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
37	It is easy for me to become skilful at using my Smartphone for education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
38	Smartphone are worth their current price	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
39	I expect to use Smartphone for education soon	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
40	I am habituated to use Smartphone for communication, search information, social networking etc.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
41	I believe use of learning resources with Smartphone is important	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
42	Using my Smartphone to access learning resources from other Universities courses is a good idea	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
43	Smartphone cost is irrelevant to the benefits	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
44	Staying connected using smartphone classmates for learning is a good idea	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
45	I intend to use Smartphone for education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
46	Using smartphones for learning resources suits my style of learning	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
47	Smartphone allows access of online learning resources anytime anywhere	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
48	Smartphone are good value for the money	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
49	I find Smartphone useful in my education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
50	Smartphone are attractive to use for university education	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

APPENDIX D: Main Survey Instrument

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FOR OFFICIAL USE
Date
Main S. No:
Data File
Comments

A DEMOGRAPHIC QUESTIONS

01	Gender	○ Female ○ Male
02	Age (years)	○ Below 18 ○ 20-18 ○ 25-21 ○ 30-26 ○ 40-31 ○ Over 40
03	I am currently a student of	○ College of Engineering ○ **College of Education**
04	I am currently enrolled in	○ Undergraduate ○ Postgraduate/Masters(Research/Courses) ○ PhD
05	Year of study for current program	○ First ○ Second ○ Third ○ Fourth
06	I own a Smartphone/Tablet	○ Smartphone ○ Tablet (Ex: iPad) ○ Both ○ None
07	My Smartphone is (make)	○ iPhone: ____ ○ Samsung: ____ ○ Other: ____
08	I am using my Smartphone since last	○ 8-7 Yrs ○ 6-5 Yrs ○ 4-3 Yrs ○ 2-1 Yrs ○ less than a year
09	**My Smartphone Operating System is**	○ Android ○ Apple iOS ○ WinOS ○ Other
10	My skill in using a Smartphone is	○ Expert User ○ Good User ○ Limited User
11	I am aware of the following FREE online learning resources	○ Open Courseware (OCW) ○ **Open Education Resources (OER)** ○ MIT **Open Education Resources** ○ Khan Academy ○ Coursera ○ Massive Open Online Courses (MOOCs) ○ iTunesU ○ None

B Do you like the idea of using your **Smartphone in University Education** for the following **ACTIVITIES**

01	**Using mobile apps (applications) for learning** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
02	Taking notes during lectures →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
03	Reading eBooks →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
04	Using online resources →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
05	**Searching for educational resources** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
06	Viewing Video or Audio recorded lectures →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
07	laboratory experiments and Data logging →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
08	Taking Assessments, quiz, surveys and polling →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
09	**Submitting assignments** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
10	**Asking questions to the lecturer** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
11	**Communicating with friends for educational help** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
12	Using Social Networking for learning →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
13	**Collaborating online for learning** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
14	**Collaborating with faculty for educational help** →	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion

C How often do you use your Smartphone for the following activities

01	Checking emails →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
02	Reading eBooks →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
03	**Distributing Files** →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
04	**Accessing Educational Content** →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
05	Playing Games →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
06	Listening to Music →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
07	Watching Movies →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
08	**Social Networking (Facebook, Twitter etc.)** →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
09	Online Banking →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never
10	Online Shopping →	○ Very Often	○ Often	○ Sometimes	○ Rarely	○ Never

UC EDUCATION **4/1**

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D Please answer the following questions about using your **Smartphone for your University Education**

01	Learning how to use my Smartphone for my education is easy for me	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
02	I have the knowledge necessary to use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
03	I use my Smartphone to communicate with my university classmates for educational help	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
04	Using my Smartphone, I frequently search for learning resources on the Internet that help in my university courses	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
05	I have the resources necessary to use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
06	My University classmates think that I should use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
07	I get pleasure using my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
08	My Smartphone is good value for the money, when used for my university education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
09	My Smartphone assists me in my University assignments	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
10	Considering its benefits, my Smartphone cost is acceptable for my university education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
11	I intend to use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
12	I collaborate with my university classmates using my Smartphone for my educational needs	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
13	My Family is supportive of the use of my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
14	My Smartphone will be the first device I will use to contact my classmates for educational help	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
15	Using my Smartphone for my education is fun	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
16	My Smartphone lets me learn anytime and anywhere	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
17	My university lecturers or supervisors encourage me to use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
18	I will always try to use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
19	Using my smartphone I get instant educational help from my university classmates	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
20	Using my Smartphone will help me get better grades in my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
21	My Family thinks that I should use my Smartphone for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion
22	My Smartphone synchronises with the desktop computer or laptop that I use for my education	◯ Strongly Agree	◯ Agree	◯ Disagree	◯ Strongly Disagree	◯ No Opinion

23	I am addicted to using my Smartphone for my education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
24	Using my Smartphone for my education is exciting	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
25	I can get help at the University when I have difficulties using my Smartphone for my education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
26	My Parents and siblings prefer that I use my Smartphone for my education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
27	My Smartphone gives me flexibility in learning when I access online content for my university education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
28	My Smartphone is compatible with my University wireless network	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
29	I connect with my university friends using my Smartphone for educational support	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
30	Using my Smartphone for my education is entertaining	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
31	I plan to continue to use my Smartphone for my education frequently	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
32	My Smartphone is reasonably priced when used for my university education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
33	I often use my Smartphone to access helpful learning content from the Internet to aid my university education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
34	The University teaching staff are supportive of the use of my Smartphone for my education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
35	I must use my Smartphone for my education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
36	I regularly access supplementary online content for my university education using my Smartphone	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
37	My Smartphone connects me to people who help me in my university education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
38	Using my Smartphone for my education is enjoyable	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
39	My Smartphone is very helpful in building connections with people who help in my university education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
40	I plan to connect with my classmates for education using my Smartphone	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
41	At the current price, my Smartphone provides good value for my university education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
42	My interaction with my Smartphone for my education is clear and understandable	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
43	Using my Smartphone for my education is pleasing	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
44	University faculty members who teach or supervise me think that I should use my Smartphone for my education	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
45	My Smartphone is central to my daily life	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion
46	Using my Smartphone will help me accomplish my learning more quickly	○ Strongly Agree	○ Agree	○ Disagree	○ Strongly Disagree	○ No Opinion

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47	Using my Smartphone for my education is effortless	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
48	I find my Smartphone useful for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
49	My University classmates encourage me to use my Smartphone for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
50	As a student, leaving my Smartphone at home would force me to go back and pick it up	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
51	I expect to use my Smartphone for my education soon	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
52	I find my Smartphone easy to use for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
53	Peers in my University prefer that I use my Smart-phone for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
54	I frequently access helpful online content for my university education using my Smartphone	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
55	I plan to use my Smartphone for accessing online resources for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
56	The use of my Smartphone has become a habit in my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
57	Staying connected with university friends with my Smartphone provides educational help when I need it	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
58	Using my Smartphone for my University education increases my productivity	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
59	It is easy for me to become skilful at using my Smartphone for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
60	My Family members encourage me to use my Smartphone for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
61	People who teach or supervise me at the university prefer that I use my Smartphone for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
62	My University friends encourage me to use my Smartphone for my education	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion

APPENDIX E: Skewness and Kurtosis

Variables	N	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic
Performance Expectancy (PEX01)	299	2.63	1.020	-1.489	1.702
Performance Expectancy (PEX02)	299	2.32	1.112	-.962	.106
Performance Expectancy (PEX03)	299	2.80	1.036	-1.412	1.820
Performance Expectancy (PEX04)	299	2.31	1.072	-.719	-.003
Performance Expectancy (PEX05)	299	1.82	1.294	-.271	-1.252
Performance Expectancy (PEX06)	299	2.18	1.160	-.650	-.491
Effort Expectancy (EEX01)	299	2.86	.974	-1.506	2.598
Effort Expectancy (EEX02)	299	2.53	1.018	-1.329	1.173
Effort Expectancy (EEX03)	299	2.63	1.071	-1.405	1.402
Effort Expectancy (EEX04)	299	2.28	1.145	-.743	-.186
Effort Expectancy (EEX05)	299	2.41	1.157	-1.095	.134
Social Influence (SI01)	299	1.57	1.358	-.015	-1.560
Social Influence (SI02)	299	1.61	1.327	-.100	-1.529
Social Influence (SI03)	299	1.40	1.258	.143	-1.369
Social Influence (SI04)	297	1.99	1.440	-.409	-1.419
Social Influence (SI05)	299	1.63	1.328	-.062	-1.420
Social Influence (SI06)	299	1.69	1.254	-.077	-1.195
Social Influence (SI07)	299	1.57	1.289	-.032	-1.413
Social Influence (SI08)	299	1.78	1.313	-.267	-1.366
Social Influence (SI09)	299	1.75	1.400	-.187	-1.535
Social Influence (SI10)	299	1.81	1.346	-.295	-1.400
Social Influence (SI11)	299	1.66	1.350	-.134	-1.510
Social Influence (SI12)	299	1.78	1.360	-.263	-1.467
Facilitating Conditions (FC01)	299	2.67	.927	-1.253	1.978
Facilitating Conditions (FC02)	296	2.97	.825	-1.461	3.751
Facilitating Conditions (FC03)	294	2.47	1.159	-.627	-.333
Facilitating Conditions (FC04)	299	2.02	1.163	-.575	-.769
Facilitating Conditions (FC05)	299	3.14	.830	-1.643	4.181
Facilitating Conditions (FC06)	299	2.55	.987	-1.139	1.093
Facilitating Conditions (FC10)	299	2.70	.942	-1.676	2.715
Facilitating Conditions (FC11)	299	2.36	1.186	-.888	-.117
Facilitating Conditions (FC12)	299	2.72	1.015	-1.385	1.792
Facilitating Conditions (FC13)	299	2.60	1.033	-1.214	1.169
Facilitating Conditions (FC14)	299	2.62	1.040	-1.400	1.468
Facilitating Conditions (FC15)	299	2.63	.992	-1.448	1.802
Facilitating Conditions (FC16)	299	2.93	.963	-1.350	2.208
Facilitating Conditions (FC17)	299	2.78	.981	-1.591	2.601
Hedonic Motivation (HM01)	299	2.25	1.263	-.807	-.624
Hedonic Motivation (HM02)	297	2.19	1.239	-.733	-.664
Hedonic Motivation (HM03)	299	2.18	1.219	-.726	-.592
Hedonic Motivation (HM04)	299	2.12	1.260	-.638	-.873
Hedonic Motivation (HM05)	299	2.16	1.151	-.736	-.471
Hedonic Motivation (HM06)	299	2.10	1.288	-.609	-.931

Price Value (PR01)	299	2.31	1.196	-.911	-.281
Price Value (PR02)	299	2.52	1.202	-1.109	.246
Price Value (PR03)	299	2.37	1.150	-1.023	-.006
Price Value (PR04)	299	2.34	1.203	-.891	-.251
Habit (HA01)	298	2.44	1.045	-.961	.517
Habit (HA02)	299	1.86	.945	.044	-.014
Habit (HA03)	299	2.03	1.096	-.344	-.545
Habit (HA04)	299	2.54	1.037	-.340	-.403
Habit (HA05)	299	2.61	1.161	-.951	.220
Habit (HA06)	299	3.04	.935	-1.263	1.876
Behaviour Intention (BI01)	299	2.51	1.047	-1.002	.640
Behaviour Intention (BI02)	299	2.20	1.130	-.675	-.274
Behaviour Intention (BI03)	299	2.51	1.063	-1.127	.742
Behaviour Intention (BI04)	299	2.59	.994	-1.362	1.551
Behaviour Intention (BI05)	299	2.43	1.128	-1.148	.349
Behaviour Intention (BI06)	298	2.63	1.065	-1.405	1.367

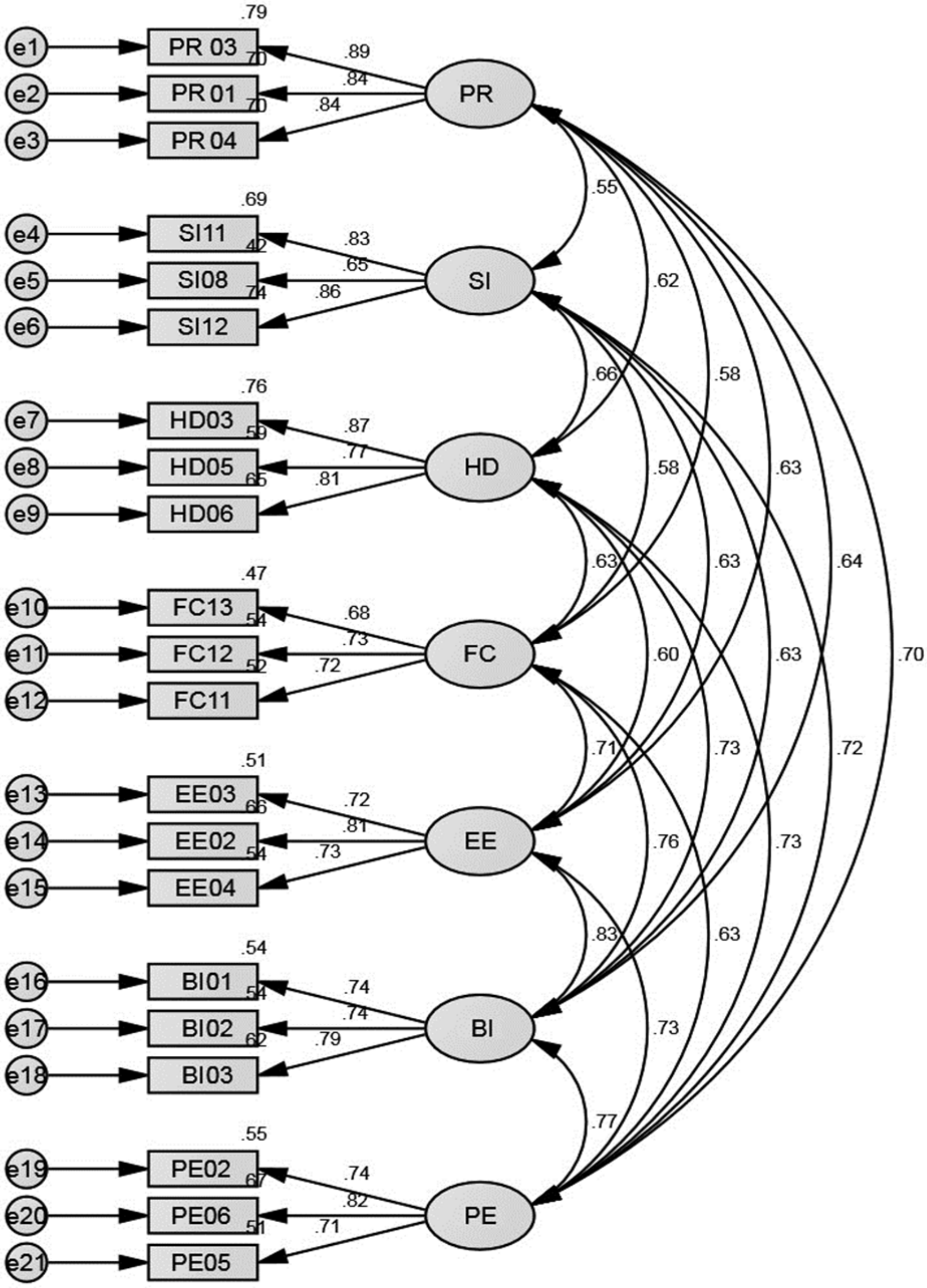
APPENDIX F: Correlation Matrix

Correlations

		SI01	SI02	SI03	SI04	SI05	SI06	SI07	SI08	SI09	SI10	SI11	SI12
SI01	Pearson Correlation	1	.688**	.635**	.555**	.556**	.506**	.532**	.493**	.476**	.511**	.527**	.570**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI02	Pearson Correlation	.688**	1	.620**	.464**	.633**	.505**	.654**	.500**	.461**	.602**	.627**	.724**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI03	Pearson Correlation	.635**	.620**	1	.474**	.510**	.423**	.576**	.430**	.455**	.510**	.544**	.552**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI04	Pearson Correlation	.555**	.464**	.474**	1	.444**	.345**	.355**	.420**	.457**	.429**	.418**	.426**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI05	Pearson Correlation	.556**	.633**	.510**	.444**	1	.539**	.725**	.623**	.460**	.630**	.653**	.663**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI06	Pearson Correlation	.506**	.505**	.423**	.345**	.539**	1	.643**	.651**	.413**	.524**	.457**	.546**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI07	Pearson Correlation	.532**	.654**	.576**	.355**	.725**	.643**	1	.652**	.456**	.580**	.592**	.702**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI08	Pearson Correlation	.493**	.500**	.430**	.420**	.623**	.651**	.652**	1	.410**	.596**	.530**	.546**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI09	Pearson Correlation	.476**	.461**	.455**	.457**	.460**	.413**	.456**	.410**	1	.547**	.465**	.521**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI10	Pearson Correlation	.511**	.602**	.510**	.429**	.630**	.524**	.580**	.596**	.547**	1	.656**	.751**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI11	Pearson Correlation	.527**	.627**	.544**	.418**	.653**	.457**	.592**	.530**	.465**	.656**	1	.721**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000
	N	299	299	299	299	299	299	299	299	299	299	299	299
SI12	Pearson Correlation	.570**	.724**	.552**	.426**	.663**	.546**	.702**	.546**	.521**	.751**	.721**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
	N	299	299	299	299	299	299	299	299	299	299	299	299

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX G: Confirmatory Factor Analysis (CFA) Measurement Model



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